

# ภาคผนวก ง

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เอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0741	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0785	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS1086	5-Jan-23	5-Jul-23	6
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0378	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0383	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0388	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Total Suspended Particulate	High Volume	BKK_FS0368	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0363	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0370	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0004	25-Feb-22	25-Feb-23	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0918	30-Aug-21	28-Feb-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	SGK_FS0039	10-Dec-22	11-Jun-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0435	26-Jan-22	27-Jul-23	18
Stack	Carbon Monoxide	Console Control Unit	BKK_FS0507	3-Jan-23	3-Jul-23	6
Stack	Carbon Monoxide	Console Control Unit	BKK_FS1093	3-Jan-23	3-Jul-23	6
Stack	Carbon Monoxide	Console Control Unit	BKK_FS0536	3-Jan-23	3-Jul-23	6
Stack	Carbon Monoxide	Flue gas Analyzer	BKK_FS1156	8-Dec-22	8-Dec-23	12
Stack	Carbon Monoxide	Flue gas Analyzer	BKK_FS1158	28-Nov-22	28-Nov-23	12
Stack	Carbon Monoxide	CO Analyzer	BKK_EN0073	7-Apr-22	7-Oct-23	18
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS0507	3-Jan-23	3-Jul-23	6
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS1093	3-Jan-23	3-Jul-23	6
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS0536	3-Jan-23	3-Jul-23	6
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS0547	3-Jan-23	3-Jul-23	6
Stack	Oxides of Nitrogen	Flue gas Analyzer	BKK_FS1156	8-Dec-22	8-Dec-23	12
Stack	Oxides of Nitrogen	Flue gas Analyzer	BKK_FS1158	28-Nov-22	28-Nov-23	12
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0896	21-Jul-22	19-Jan-24	18
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0894	21-Jul-22	19-Jan-24	18
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0895	10-May-22	8-Nov-23	18
Stack	Oxides of Nitrogen	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0507	3-Jan-23	3-Jul-23	6
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0536	3-Jan-23	3-Jul-23	6
Stack	Total Suspended Particulate	Flue gas Analyzer	BKK_FS1156	8-Dec-22	8-Dec-23	12
Stack	Total Suspended Particulate	Flue gas Analyzer	BKK_FS1158	28-Nov-22	28-Nov-23	12
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0002	8-Feb-23	8-Feb-24	12
Stack	Chromium	Console Control Unit	BKK_FS0507	3-Jan-23	3-Jul-23	6
Stack	Chromium	Flue gas Analyzer	BKK_FS1156	8-Dec-22	8-Dec-23	12
Stack	Chromium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Stack	Total Hydrocarbon as Methane	Console Control Unit	BKK_FS0507	3-Jan-23	3-Jul-23	6
Stack	Total Hydrocarbon as Methane	Console Control Unit	BKK_FS0536	3-Jan-23	3-Jul-23	6
Stack	Total Hydrocarbon as Methane	Flue gas Analyzer	BKK_FS1156	8-Dec-22	8-Dec-23	12
Stack	Total Hydrocarbon as Methane	Total Hydrocarbon Analyzer	BKK_EN0057	9-Aug-22	9-Feb-24	18
Stack	Total Hydrocarbon as Methane	FID Analyzer	BKK_FS0758	4-Jan-23	4-Jul-23	6
Stack	Total VOC as Methane	Console Control Unit	BKK_FS0507	3-Jan-23	3-Jul-23	6
Stack	Total VOC as Methane	Console Control Unit	BKK_FS0536	3-Jan-23	3-Jul-23	6
Stack	Total VOC as Methane	Flue gas Analyzer	BKK_FS1156	8-Dec-22	8-Dec-23	12
Stack	Total VOC as Methane	FID Analyzer	BKK_FS0758	4-Jan-23	4-Jul-23	6
Workplace	Respirable Dust	Field Rotameter	BKK_FS1013	3-Jan-23	3-Apr-23	3
Workplace	Respirable Dust	Field Rotameter	BKK_FS1019	17-Jan-23	17-Apr-23	3
Workplace	Respirable Dust	Field Rotameter	BKK_FS1022	3-Apr-23	3-Jul-23	3
Workplace	Respirable Dust	Digital Balance	BKK_EN0004	8-Feb-23	8-Feb-24	12
Workplace	Chromium	Field Rotameter	BKK_FS1013	3-Jan-23	3-Apr-23	3
Workplace	Chromium	Field Rotameter	BKK_FS1019	17-Jan-23	17-Apr-23	3
Workplace	Chromium	Field Rotameter	BKK_FS1022	3-Apr-23	3-Jul-23	3
Workplace	Chromium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Workplace	Silica (Quartz)	Field Rotameter	BKK_FS1013	3-Jan-23	3-Apr-23	3
Workplace	Silica (Quartz)	Field Rotameter	BKK_FS1019	17-Jan-23	17-Apr-23	3
Workplace	Silica (Quartz)	Field Rotameter	BKK_FS1022	3-Apr-23	3-Jul-23	3



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0630	26-Apr-22	26-Apr-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0098	15-Aug-22	15-Aug-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0099	11-Jul-22	11-Jul-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0100	11-Jul-22	11-Jul-23	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0630	26-Apr-22	26-Apr-23	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0111	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0631	20-Dec-22	20-Dec-23	18
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0993	25-Oct-22	25-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0994	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0995	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0996	15-Aug-22	15-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0998	19-Sep-22	19-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0999	19-Sep-22	19-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1000	19-Sep-22	19-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1214	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1215	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1217	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0632	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0111	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0875	3-Jan-23	3-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0618	7-Dec-22	7-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0923	25-Oct-22	25-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0924	25-Oct-22	25-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0925	18-Oct-22	18-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0926	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0927	18-Oct-22	18-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0997	19-Jan-23	19-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0998	19-Sep-22	19-Sep-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0641	26-May-22	26-May-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0642	14-Feb-22	14-Feb-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0643	31-May-22	31-May-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0649	17-Mar-22	17-Mar-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0669	8-Jul-22	8-Jul-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0662	27-May-22	27-May-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0667	13-Feb-23	13-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0655	28-Sep-22	28-Sep-23	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0660	8-Jul-22	8-Jul-23	12
Water Lab	pH at 25 °C	pH meter	BKK_EN0072	12-Sep-22	12-Mar-24	18
Water Lab	Oil & Grease	Electronic Top-Loading Ba	BKK_EN0002	8-Feb-23	8-Feb-24	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	31-Jan-22	1-Aug-23	18
Water Lab	Total Suspended Solids	Electronic Top-Loading Ba	BKK_EN0002	8-Feb-23	8-Feb-24	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0273	29-Nov-22	29-May-24	18
Water Lab	BOD	DO Meter	BKK_EN0017	24-May-22	24-Nov-23	18
Water Lab	BOD	Incubator	BKK_EN0272	17-May-22	17-May-23	12
Water Lab	COD	Hot Block	BKK_EN0222	1-Mar-23	1-Mar-24	12
Water Lab	COD	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Temperature	Digital Thermometer With	BKK_LG0054	12-Sep-22	12-Sep-23	12
Water Lab	Temperature	Digital Thermometer With	BKK_LG0055	12-Sep-22	12-Sep-23	12
Water Lab	Temperature	Digital Thermometer With	BKK_LG0067	12-Sep-22	12-Sep-23	12

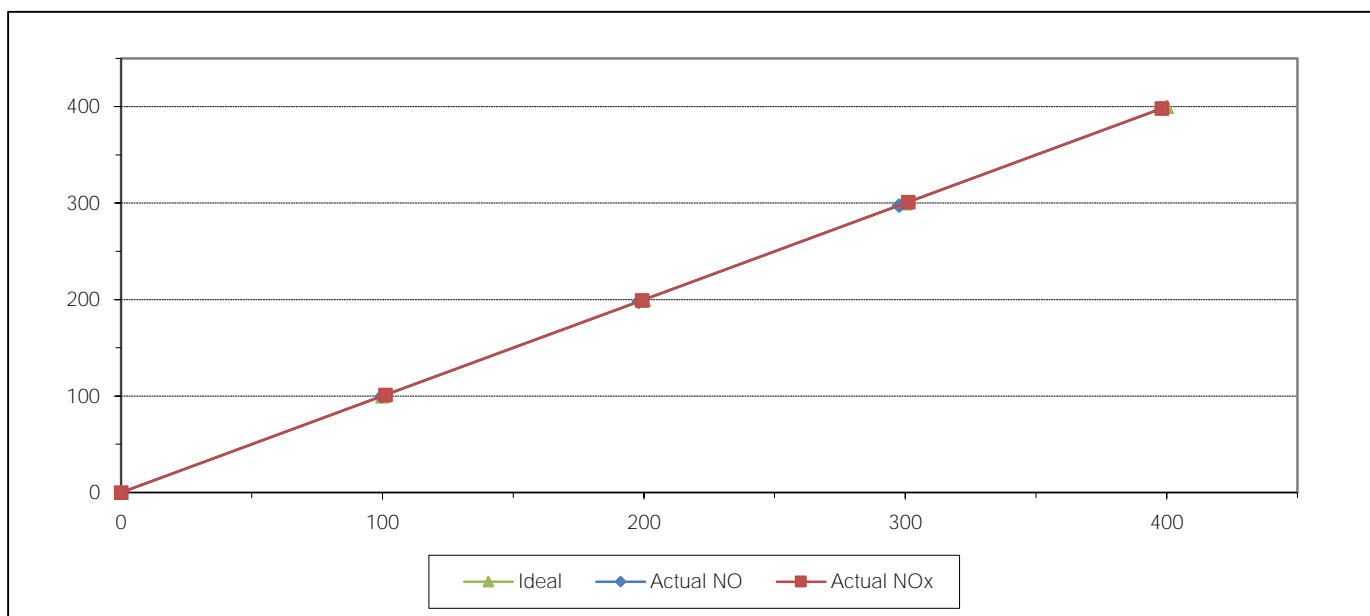


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer Teledyne API  
Serial No. 060  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 55.88  
Cylinder Pressure (psi) 1800  
Certified Date 9-Feb-22

Equipment Name NOx Analyzer  
Model T200  
Equipment ID BKK\_FS0741  
Model 700  
Cylinder No. GN0027222  
Certified By Airgas Inc.  
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	99.80	-0.20	-0.20	101.20	1.20	1.20
2	200.00	198.10	-1.90	-0.95	199.30	-0.70	-0.35
3	300.00	297.60	-2.40	-0.80	301.10	1.10	0.37
4	400.00	398.20	-1.80	-0.45	398.20	-1.80	-0.45
AVERAGE (%)				-0.46			0.17



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager



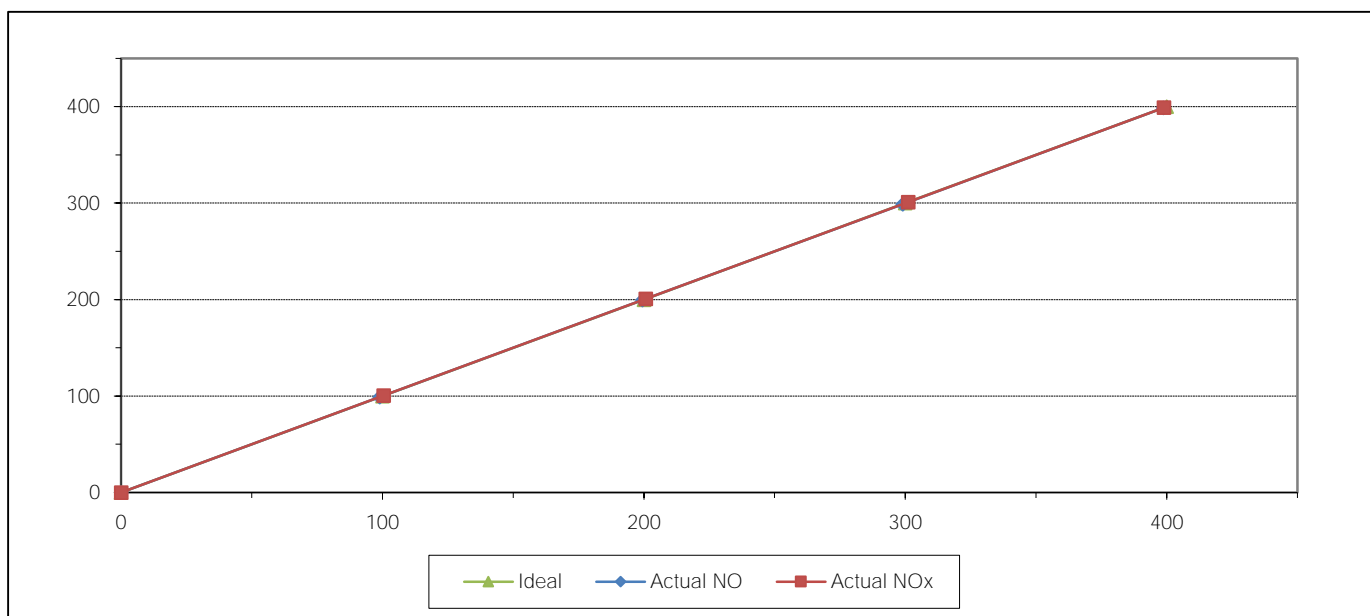


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer HORIBA  
Serial No. TLTATGDW  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 55.88  
Cylinder Pressure (psi) 1800  
Certified Date 9-Feb-22

Equipment Name NOx Analyzer  
Model APNA-370  
Equipment ID BKK\_FS0785  
Model 700  
Cylinder No. GN0027222  
Certified By Airgas Inc.  
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	100.50	0.50	0.50
2	200.00	199.50	-0.50	-0.25	200.70	0.70	0.35
3	300.00	299.00	-1.00	-0.33	301.10	1.10	0.37
4	400.00	398.70	-1.30	-0.33	399.00	-1.00	-0.25
AVERAGE (%)				-0.36			0.21



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager

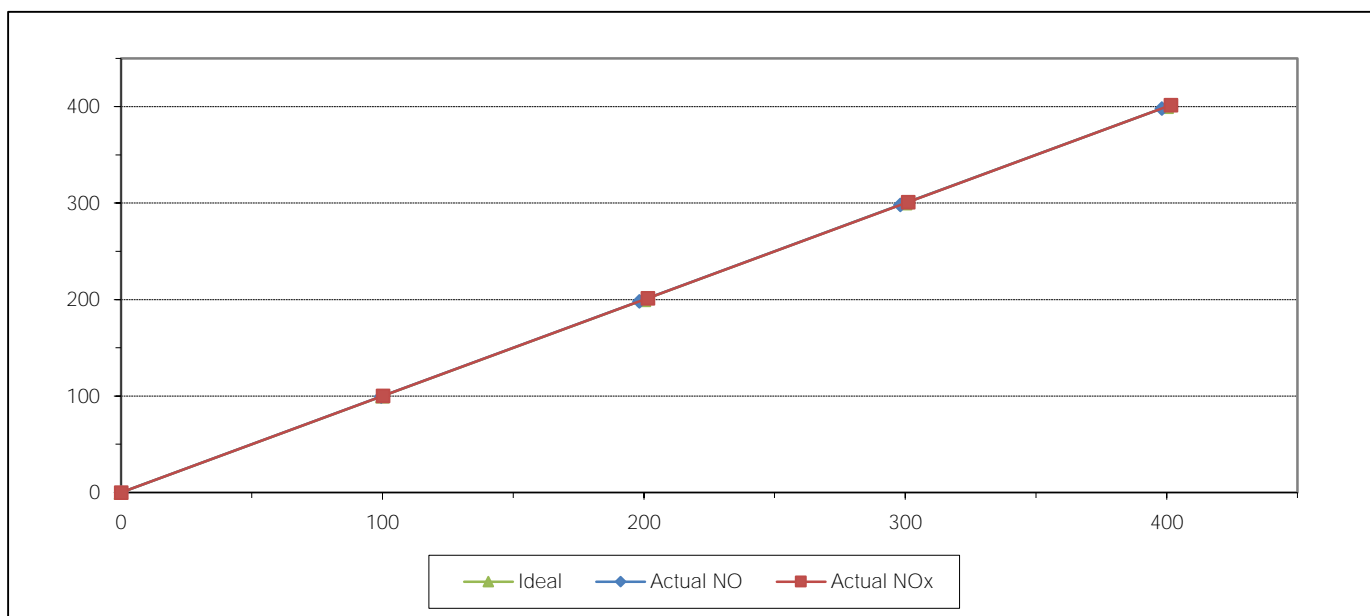


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer HORIBA  
Serial No. 30K18RHM  
Calibrator Manufacturer Teledyne API  
Serial No. 947  
Std. Gas Concentration (PPM) 55.88  
Cylinder Pressure (psi) 1800  
Certified Date 9-Feb-22

Equipment Name NOx Analyzer  
Model APNA-370  
Equipment ID BKK\_FS1086  
Model 700  
Cylinder No. GN0027222  
Certified By Airgas Inc.  
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	100.20	0.20	0.20
2	200.00	198.30	-1.70	-0.85	201.60	1.60	0.80
3	300.00	298.10	-1.90	-0.63	301.10	1.10	0.37
4	400.00	398.20	-1.80	-0.45	401.60	1.60	0.40
AVERAGE (%)				-0.48			0.37



Calibrated By

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

Approved By

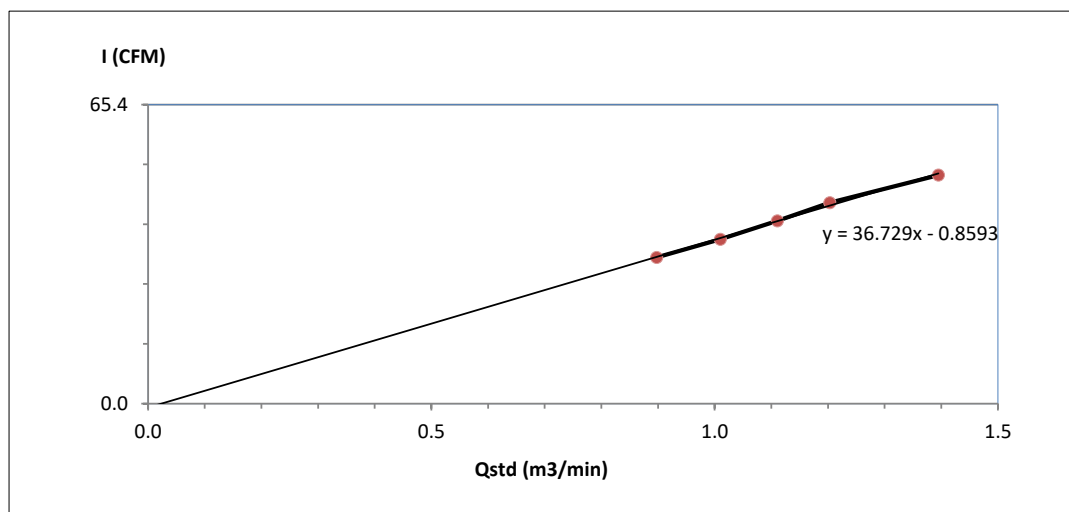
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	วัดรองแสง (A1)	Temperature ( °C ) :	30
Calibrate Date :	23-Jan-23	High Volume ID :	BKK_FS0378
Calibration Sheet No.:	C-230123-BKK_FS0378	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	4155
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67326
Calibrator S/N :	2585	Calibrator Intercept :	-0.01954

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.2	0.8975	32	Slope : 36.7289 Intercept : -0.8593 Correlation Coefficient : 0.9983
2	2.8	1.0100	36	
3	3.4	1.1109	40	
4	4.0	1.2033	44	
5	5.4	1.3950	50	



Calibrated by 

( Mr. Thananat Anake )  
Field Scientist(2)

Approved by : 

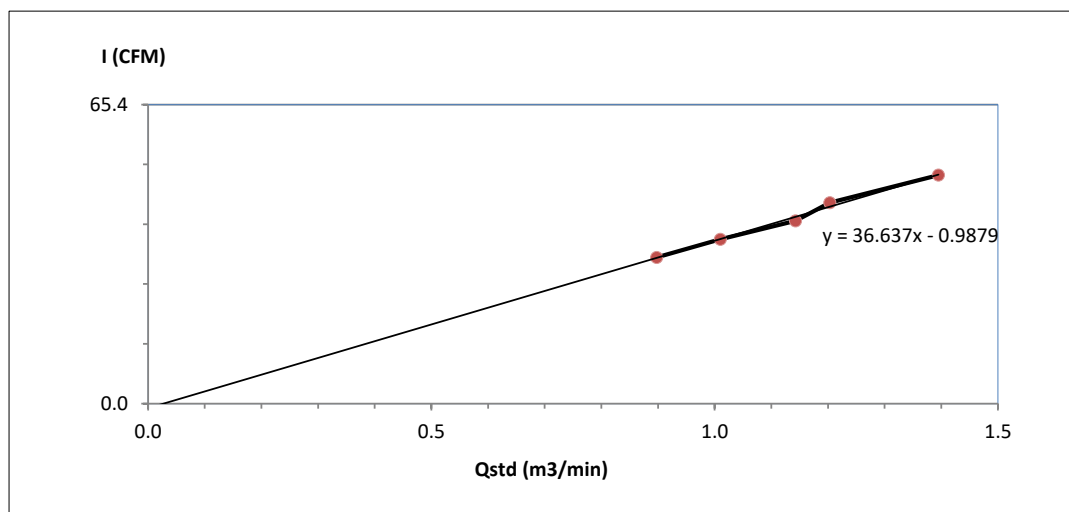
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านบัวลอย (A2)	Temperature ( °C ) :	30
Calibrate Date :	23-Jan-23	High Volume ID :	BKK_FS0383
Calibration Sheet No.:	C-230123-BKK_FS0383	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	4787
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67326
Calibrator S/N :	2585	Calibrator Intercept :	-0.01954

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.2	0.8975	32	Slope : 36.6370 Intercept : -0.9879 Correlation Coefficient : 0.9959
2	2.8	1.0100	36	
3	3.6	1.1426	40	
4	4.0	1.2033	44	
5	5.4	1.3950	50	



Calibrated by 

( Mr. Thananat Anake )  
Field Scientist(2)

Approved by : 

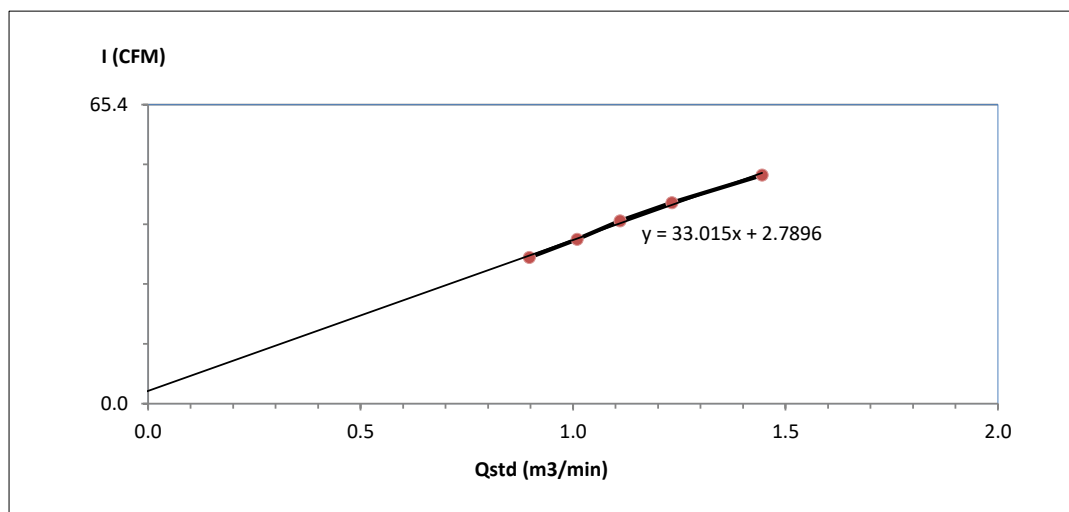
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	วัดท่าช้าง (A3)	Temperature ( °C ) :	30
Calibrate Date :	23-Jan-23	High Volume ID :	BKK_FS0388
Calibration Sheet No.:	C-230123-BKK_FS0388	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	5328
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67326
Calibrator S/N :	2585	Calibrator Intercept :	-0.01954

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.2	0.8975	32	Slope : 33.0148 Intercept : 2.7896 Correlation Coefficient : 0.9975
2	2.8	1.0100	36	
3	3.4	1.1109	40	
4	4.2	1.2326	44	
5	5.8	1.4450	50	



Calibrated by 

( Mr. Thananat Anake )  
Field Scientist(2)

Approved by : 

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



## Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.:	PTC/07/22072	Page:	1 of 3
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	METTLER TOLEDO	Serial No:	1123091884
Model:	XP105	ID No:	BKK_EN0004
Type of Balance:	Multi interval		



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

Environment Condition: Temperature 21.0 °C ± 0.4 °C  
Humidity 62.8 %RH ± 3.7 %RH  
Air density 1.20 kg/m<sup>3</sup>



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.

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





Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.: PTC/07/22072

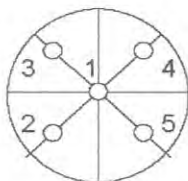
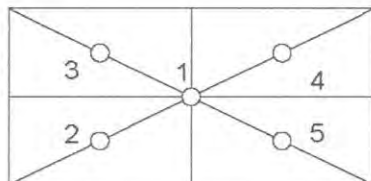
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## Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 30 (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  $1/2 \leq L_1 \leq$  Maximum capacity

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

Nominal test value (g)	Standard Deviation
100	0.00005

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
40	40.00005	40.0000	0.0000	0.00016	2.11
50	50.00001	50.0000	0.0000	0.00015	2.13
60	60.00003	60.0000	0.0000	0.00016	2.08
70	70.00003	70.0000	0.0000	0.00017	2.07
80	80.00005	80.0001	-0.0001	0.00019	2.04
90	90.00006	90.0001	0.0000	0.00020	2.03
100	100.00002	99.9999	0.0001	0.00018	2.06

Note: Weight of adjust - (g)



Represent to Certificate of Calibration ,PTC/07/22072

Certificate No.: PTC/07/22072

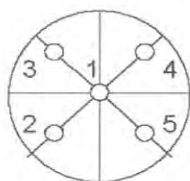
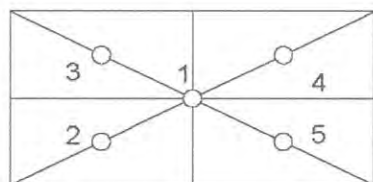
Page: 3 of 3

## Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 30 (g)

Position (g)				
1	2	3	4	5
0.00000	-0.00001	-0.00002	0.00000	0.00000
Maximum deviation:			0.00002	

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

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

Nominal test value (g)	Standard Deviation
20	0.000005

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	0.000016	2.52
0.1	0.100000	0.10000	0.00000	0.000019	2.00
0.5	0.499999	0.50000	0.00000	0.000019	2.00
2	2.000010	1.99999	0.00002	0.000024	2.00
5	5.000005	5.00001	0.00000	0.000027	2.00
10	10.000015	10.00001	0.00000	0.000031	2.00
20	20.000019	20.00001	0.00001	0.000042	2.00
30	30.000034	30.00006	-0.00003	0.000069	2.00

Note: Weight of adjust - (g)

The End of Certificate

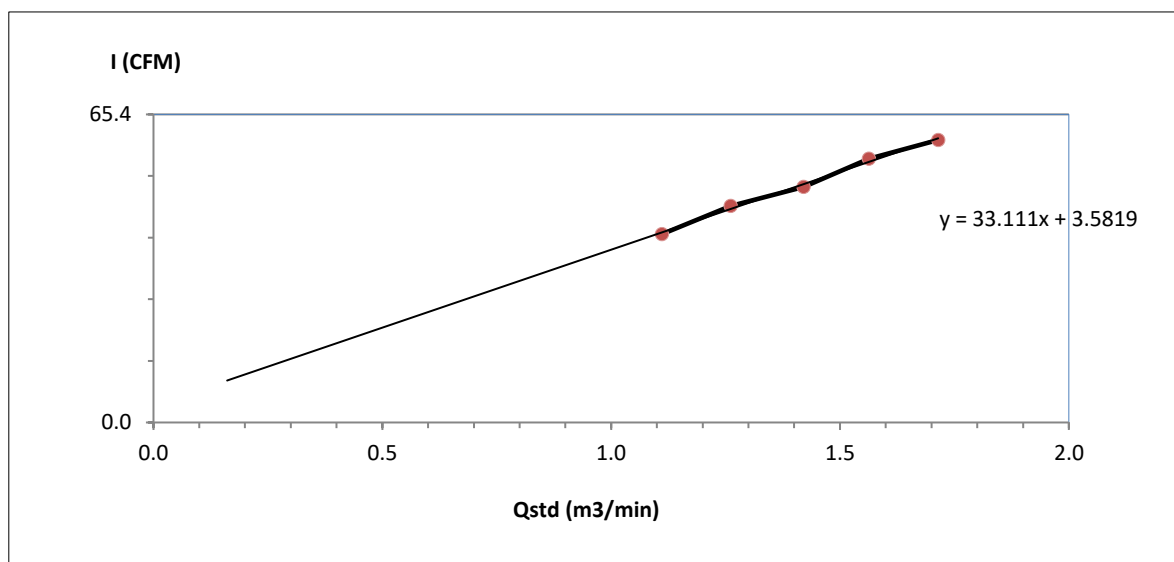




## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	วัดร้องแซง (A1)	Temperature ( °C ) :	30
Calibrate Date :	23-Jan-23	High Volume ID :	BKK_FS0368
CalibrationSheet No.:	C-230123-BKK_FS0368	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	4165
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67326
Calibrator S/N :	2585	Calibrator Intercept :	-0.01954

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.4	1.1109	40	Slope : 33.1113 Intercept : 3.5819 Correlation Coefficient : 0.9970
2	4.4	1.2611	46	
3	5.6	1.4202	50	
4	6.8	1.5630	56	
5	8.2	1.7145	60	



Calibrated by   
 ( Mr. Thananat Anake )  
 Field Scientist(2)

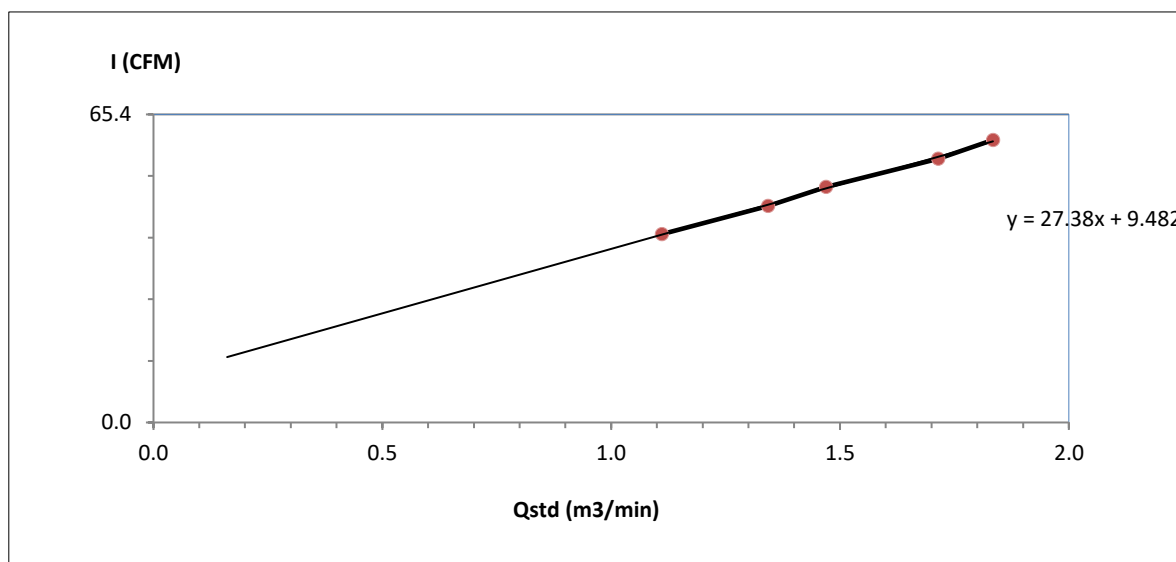
Approved by :   
 (Mr. Noppong Juntarupan)  
 Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านบัวลอย (A2)	Temperature ( °C ) :	30
Calibrate Date :	23-Jan-23	High Volume ID :	BKK_FS0363
CalibrationSheet No.:	C-230123-BKK_FS0363	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	4160
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67326
Calibrator S/N :	2585	Calibrator Intercept :	-0.01954

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.4	1.1109	40	Slope : 27.3803 Intercept : 9.4820 Correlation Coefficient : 0.9992
2	5.0	1.3431	46	
3	6.0	1.4694	50	
4	8.2	1.7145	56	
5	9.4	1.8343	60	



Calibrated by \_\_\_\_\_

( Mr. Thananat Anake )  
Field Scientist(2)

Approved by : \_\_\_\_\_

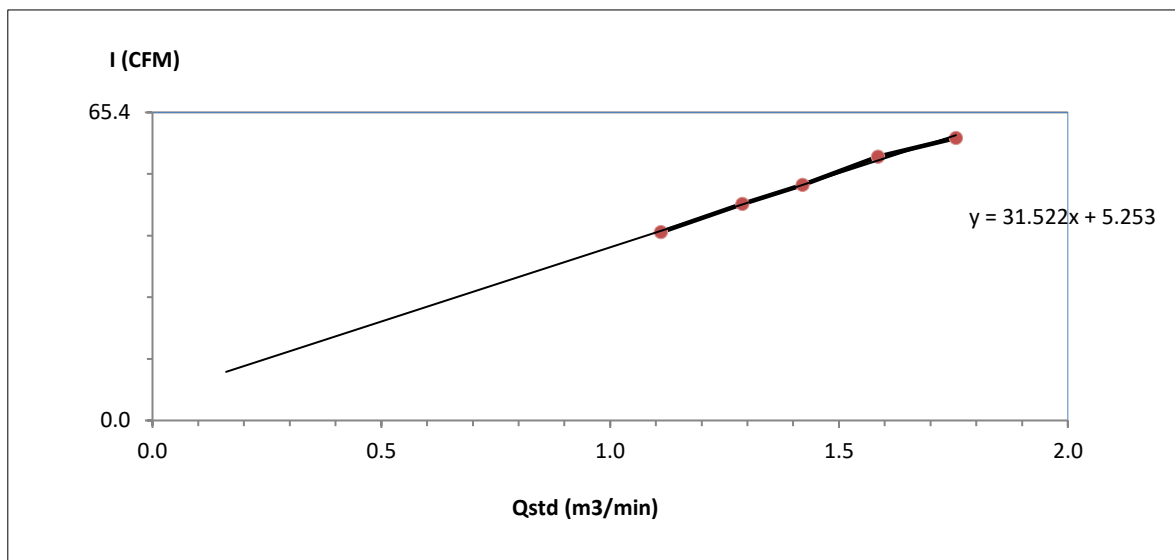
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	วัดท่าช้าง (A3)	Temperature ( °C ) :	30
Calibrate Date :	23-Jan-23	High Volume ID :	BKK_FS0370
CalibrationSheet No.:	C-230123-BKK_FS0370	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	4798
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67326
Calibrator S/N :	2585	Calibrator Intercept :	-0.01954

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.4	1.1109	40	Slope : 31.5224 Intercept : 5.2530 Correlation Coefficient : 0.9980
2	4.6	1.2890	46	
3	5.6	1.4202	50	
4	7.0	1.5856	56	
5	8.6	1.7553	60	



Calibrated by   
 ( Mr. Thananat Anake )  
 Field Scientist(2)

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

## CERTIFICATE OF CALIBRATION

Certificate No: WS-08082021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

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

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

Serial Number : Data logger: A5378.  
: Cup anemometer: -.

ID No : Data logger: BKK\_FS0918.  
: Cup anemometer: -.

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

REVIEW BY	<i>Nirakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	28/2/23

Test Conditions : Wind tunnel cross test section area 900 cm<sup>2</sup>  
: Anemometer frontal area 100 cm<sup>2</sup>  
: Diameter of mounting pipe - mm  
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 22.6 ±0.8 °C  
: Air pressure 1009.6 ±0.4 hPa  
: Relative air humidity 50.4 ±3.5 %RH

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

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

Measurement Date : Aug 30, 2021.  
Issued Date : Aug 31, 2021.

Calibrated by

- ☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

*[Signature]*

Mr. Parinya Booncharoen  
Technical Support  
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-08082021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

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

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

V <sub>STD</sub> Reading m/s	V <sub>UUC*</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.021	1.8	-0.2	2.9
4.074	3.9	-0.2	1.6
5.98	6.0	0.0	0.99
8.03	8.0	0.0	0.84
10.03	10.2	0.2	0.66
11.99	12.3	0.3	0.95
13.98	14.4	0.4	0.47
16.00	16.6	0.6	0.48
15.02	15.5	0.5	0.69
12.98	13.4	0.4	0.67
10.99	11.2	0.2	0.69
8.97	9.0	0.0	0.97
7.01	7.0	0.0	0.90
5.085	5.0	-0.1	0.96
2.970	3.0	0.0	1.7
1.019	0.7	-0.3	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	TESTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

\*\*\*End of certificate of calibration\*\*\*





## CERTIFICATE OF CALIBRATION

Certificate No.: WD-07082021

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: A5378.  
: Wind direction sensor: -.

ID No : Data logger: BKK\_FS0918.  
: Wind direction sensor: -.

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

### Environmental Condition:

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

### Measurement Method:

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

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

### Traceability:

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

Measurement Date : Aug 30, 2021.  
Issued Date : Aug 31, 2021.

### Performed by

- ☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.  
Technical Support  
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-07082021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	43	-2	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	180	0	3.0
6		225	225	228	3	3.0
7		270	270	274	4	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	43	-2	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	180	0	3.0
14		225	225	228	3	3.0
15		270	270	274	4	3.0
16		315	315	319	4	3.0

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

\*\*\*End of Certificate of Calibration\*\*\*







JIRANATEE ASSOCIATES CO., LTD.

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Web site: www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department.

REVIEW BY	Manakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	10/19/23 11/6/24

Certificate Number

CL-016-65

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-005  
Data logger: A5447  
**ID NUMBER** : SGK\_FS0039  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 07 Dec 2022  
**MEASUREMENT DATE** : 10 Dec 2022  
**ISSUE DATE** : 12 Dec 2022

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<b>CALIBRATION CONDITIONS</b>	: Wind tunnel cross-section area <sup>1</sup>	900	cm <sup>2</sup>
	Win direction frontal area <sup>2</sup>	100	cm <sup>2</sup>
	Diameter of mounting pipe <sup>3</sup>	-	mm
	Blockage ratio of test object <sup>4</sup>	0.111	[-]

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.1) °C, (47.2) %RH and (1009.8) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittragoon Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

- <sup>1</sup> Nozzle cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>



**MEASUREMENT RESULTS <sup>5</sup>**

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

$v_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{uuc}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.985	23.94	24.05	0.8	-0.2	0.14
2.050	24.10	24.05	1.9	-0.2	0.16
3.026	23.92	24.05	2.9	-0.1	0.17
4.234	24.20	24.05	3.9	-0.3	0.20
5.03	23.80	24.05	4.9	-0.1	0.19
6.02	24.10	24.05	5.9	-0.1	0.18
7.07	23.76	24.05	6.9	-0.2	0.17
8.18	23.76	24.05	8.1	-0.1	0.19
9.11	23.86	24.05	8.9	-0.2	0.19
10.09	23.78	24.05	10.0	-0.1	0.22
11.16	23.90	24.05	10.8	-0.3	0.21
12.13	23.76	24.05	12.1	0.0	0.20
13.20	23.90	24.05	13.0	-0.2	0.25
14.26	23.88	24.05	14.0	-0.2	0.30
15.25	24.00	24.05	14.9	-0.3	0.23
16.31	24.00	24.05	16.0	-0.3	0.26

**Remark:**

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Velocity of standard

<sup>7</sup> Velocity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**

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

\*\*\*End of Certificate of Calibration\*\*\*







JIRANATEE ASSOCIATES CO.,LTD.

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

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-016-65

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-005  
Data logger: AS447  
**ID NUMBER** : SGK\_FS0039  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) co., ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 07 Dec 2022  
**MEASUREMENT DATE** : 12 Dec 2022  
**ISSUE DATE** : 12 Dec 2022

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<b>CALIBRATION CONDITION</b>	: Wind tunnel cross-section area <sup>1</sup>	900	cm <sup>2</sup>
	Win direction frontal area <sup>2</sup>	129	cm <sup>2</sup>
	Diameter of mounting pipe <sup>3</sup>	-	mm
	Blockage ratio of test object <sup>4</sup>	0.143	[-]

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.0)°C, (50.1) %RH and (1011.8) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

- <sup>1</sup> Nozzle cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>

MEASUREMENT RESULTS<sup>5</sup>

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

Air speed m/s	$D_{std}^6$ Degree (°)	$D_{uuc}^7$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
5.02	0.001	0	0	0.58
	45.000	41	-4	0.74
	90.001	87	-3	0.68
	135.000	133	-2	0.74
	180.001	181	1	0.68
	225.000	229	3	0.76
	270.001	275	5	0.74
	315.000	320	5	0.74

## Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Direction of standard

<sup>7</sup> Direction of Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*







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CALIBRATION 0367

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CL-019-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer  
MANUFACTURER : Novalynx  
MODEL/TYPE : 110-WS-25BP  
SERIAL NUMBER : A5447  
ID NUMBER : SGK\_FS0039  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : ALS laboratory group (Thailand) co., ltd.  
104 Phatthanakan 40, Phatthanakan Rd,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

RECEIVED DATE : 07 Dec 2022  
MEASUREMENT DATE : 10 Dec 2022  
ISSUE DATE : 12 Dec 2022

### Calibration procedure:

The pressure calibration was done by In-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-R 6-1

### Traceability:

The measurement results are traceable to the international system of units (SI) through MENSOR which complies with the requirements of ISO/IEC17025:2017, ANSI/NCCL 2540-1 via Certificate number: 201479

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

### CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	410018L1	201479	13 Sep 2022

1. Calibration effort for calibration sequence A

2. The UUC\* was installed in vertical orientation above reference standard instrument and center of UUC\* was used as the reference level.

3. Calibration conditions:

4. Condition : ☒ Normal ☐ Abnormal

Pressure transmitting medium : Air

$\rho_{F1}$  (20°C, 1 bar) : 1.19 kg/m<sup>3</sup>

$H_{amb}$  : (55±15) %

$t_{amb}$  : (23±3) °C

$p_{amb}$  : (1010±10) mbar

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

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager



JIRANATEE ASSOCIATES CO.,LTD.

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Mobile: +66863999453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CL-019-65

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 – 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	950.4	0.4	0.61
970.00	970.2	0.2	0.48
990.00	990.0	0.0	0.37
1010.00	1009.7	-0.3	0.52
1030.00	1029.5	-0.5	0.66
1050.00	1049.2	-0.8	0.95

Note: UUC\* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

\*End of certificate\*





## CERTIFICATE OF CALIBRATION

Certificate No: WS-04012022

Page 1 of 2 pages

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-02F		
Serial Number	: Data logger: A5444 : Cup anemometer: WSD-003		
ID No	: Data logger: RYG_FS0435 : Cup anemometer: -		
Customer	: ALS laboratory group (Thailand) co., ltd. : 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260 Thailand.		
Test Conditions	: Wind tunnel cross test section area	900	cm <sup>2</sup>
	: Anemometer frontal area	100	cm <sup>2</sup>
	: Diameter of mounting pipe	-	mm
	: Blockage ratio of test object	0.111	[-]
Test Conditions	: Air temperature	24.4	±0.8 °C
	: Air pressure	1011.2	±0.4 hPa
	: Relative air humidity	55.6	±3.5 %RH
Calibration Procedure	Calibration was carried out base on; IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines; MEASNET Anemometer Calibration Procedure – Version 2: 2009;		
Traceability	This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).		
Measurement Date	: JAN 26, 2022.		
Issued Date	: JAN 31, 2022.		



**Calibrated by**

- ☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



**Approved Signatory:**

*Handwritten signature*  
Mr. Parinya Booncharoen  
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-04012022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

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

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

V <sub>STD</sub> Reading m/s	V <sub>UUC</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.070	2.0	-0.1	2.4
4.105	4.1	0.0	1.2
6.01	6.0	0.0	0.99
8.01	8.0	0.0	0.71
10.01	10.1	0.1	1.1
12.01	12.2	0.2	0.65
13.98	14.3	0.3	0.61
15.94	16.1	0.2	1.4
14.98	15.1	0.1	1.0
13.00	13.1	0.1	0.76
11.02	11.1	0.1	0.63
9.02	9.0	0.0	0.97
7.03	7.0	0.0	0.84
5.166	5.1	-0.1	1.2
2.996	3.0	0.0	1.6
1.029	0.9	-0.1	4.5

UUC\*: Unit Under Calibration

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

#### Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TCSTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

\*\*\*End of certificate of calibration\*\*\*



## CERTIFICATE OF CALIBRATION

Certificate No.: WD-04012022

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-02F

Serial Number : Data logger: A5444  
: Wind direction sensor: WSD-003

ID No : Data logger: RYG\_FS0435  
: Wind direction sensor: -

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

### Environmental Condition:

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

### Measurement Method:

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

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

### Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : JAN 25, 2022.

Issued Date : JAN 31, 2022.

### Performed by

- ☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.  
Calibration Department Manager



Continuation of Certificate of Calibration Number

Certificate No: WD-04012022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	272	2	3.0
8		315	315	317	2	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	272	2	3.0
16		315	315	317	2	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\*\*\*



## CALIBRATION REPORT

Calibration No. : RH-04012022

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-25DL-D  
: Relative humidity sensor: HMP60

Serial Number : Data logger: A5444  
: Relative humidity sensor: R1131112

ID No : Data logger: RYG\_FS0435  
: Relative humidity 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  $(25 \pm 3)^{\circ}\text{C}$ , and relative humidity of  $(50 \pm 15)\%$ .

### Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution  $\text{CH}_3\text{COOK}$ : Potassium Acetate,  $\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate,  $\text{KCl}$ : Potassium Chloride to determine the errors.

Measurement Date : JAN 24, 2022

Issued Date : JAN 25, 2022

### Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC <sub>(Reading)</sub>	Error
$\text{CH}_3\text{COOK}$ : Potassium Acetate	22.51	22.3	-0.2
$\text{Mg}(\text{NO}_3)_2$ : Magnesium Nitrate	52.89	52.5	-0.4
$\text{KCl}$ : Potassium Chloride	84.34	84.1	-0.2

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Orathai Wiwatwittaya



Approved Signatory: .....

Mr. Parinya Booncharoen.  
Calibration Department Manager

## CALIBRATION REPORT

Calibration Number. : RG-04012022

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger.

Manufacturer : Data logger: Novalynx.  
: Rain gauge: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D  
: Rain gauge: 110-WS-25RG

Serial Number : Data logger: A6444  
: Rain gauge: RG-003

ID NO : RYG\_FS0435

Customer : ALS laboratory group (Thailand) co., ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10260, Thailand.

### Environmental Condition:

The measurement was carried out in an ambient temperature of  $(25 \pm 3)^{\circ}\text{C}$ , and relative humidity of  $(50 \pm 15)\%$ .

### Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

1. Obtain rain gauge inlet area:  
Rain gauge precise diameter in cm = Diameter/2 = R (radius)  
Rain gauge area =  $R^2 \times 3.14$  (UUC diameter=20.3 cm, UUC radius=10.15 cm)  
Rain gauge area =  $323.6 \text{ cm}^2$ .
2. Obtain theoretical correct rain gauge answer (number of tippings) using  $323.6 \text{ cm}^2$  inlet area and 0.5 L of rain.
  - a)  $10,000 \text{ cm}^3 / 323.6 \text{ cm}^2$  inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
  - b)  $30.90 \times 0.5 \text{ L volume} = 15.45 \text{ mm}$  (mm of rain over  $1 \text{ m}^2$  surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain.
  - c) Number of tipping =  $15.45 / 0.25 \text{ mm} = 62$  tippings.

*Note: Rain gauge is fully cleaned and leveling prior the calibration performed.*

Measurement Date : JAN 28, 2022  
Issued Date : JAN 31, 2022

### Performed by

- ☒ Mr. Sorawit Thachalad  
☐ Miss Orathai Wiwatwittaya



Approved Signatory: .....

Mr. Parinya Booncharoen.  
Calibration Department Manager



Continuation of Calibration of Calibration Number

Calibration Number: RG-04012022

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Quantity of H <sub>2</sub> O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	64	60 - 64
500	62	63	60 - 64
500	62	62	60 - 64
500	62	63	60 - 64
500	62	62	60 - 64

*Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within  $\pm 2\%$  different from the 62 tipping (correct range: 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.*

\*\*\*End of calibration report\*\*\*



## CERTIFICATE OF CALIBRATION

Certificate No. : CL-005-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer  
MANUFACTURER : Novalynx  
MODEL/TYPE : 110-WS-25BP  
SERIAL NUMBER : A5444  
ID NUMBER : RYG\_FS0435  
CUSTOMER : ALS laboratory group (Thailand) co., ltd.  
104 Phatthanakan 40, Phatthanakan Rd,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.  
RECEIVED DATE : 12 Jan 2022  
MEASUREMENT DATE : 29 Jan 2022  
ISSUE DATE : 31 Jan 2022

### Calibration procedure:

The pressure calibration was done by In-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-R 6-1

### Traceability:

The measurement results are traceable to the international system of units (SI) through MENSOR which complies with the requirements of ISO/IEC17025:2017, ANSI/NCSL Z540-1 via Certificate number: 201479

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

### CONDITION OF THIS RESULT OF CALIBRATION:

#### 1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	410018L1	201479	13 Sep 2022

#### 2. The UUC\* was installed in vertical orientation above reference standard instrument and center of UUC\* was used as the reference level.

#### 3. Calibration conditions:

Pressure transmitting medium : Air  
 $\rho_F(20^\circ\text{C}, 1\text{bar})$  :  $1.19 \text{ kg/m}^3$   
 $\Delta h$  :  $-0.080 \text{ m}$   
 $t_{amb}$  :  $(23 \pm 2)^\circ\text{C}$   
 $p_{amb}$  :  $1009.5 \text{ mbar}$

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

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Oratai Wiwatwittaya



### Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 – 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty(k=2) (mbar)
950.32	951.181	0.856	1.3
970.14	970.682	0.538	0.70
990.05	990.524	0.470	0.58
1009.95	1010.106	0.157	0.34
1029.84	1029.946	0.107	0.25
1049.78	1049.594	-0.190	0.35

Note: UUC\* Unit Under Calibration

\*End of certificate\*





## CERTIFICATE OF CALIBRATION

Certificate No.: CL-004AB-65  
Page 1 of 2

**Equipment Name:** Data Logger with Temperature  
Sensor

**Manufacturer:** Novalynx

**Model:** 110-WS-25DL-D

**Serial No.:** A5444

**ID No.:** RYG\_FS0435

**Customer**

**Name:** ALS laboratory group (Thailand) Co.,Ltd.

**Address:** 104 Phatthanakan 40, Phatthanakan  
Rd.,Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250Thailand.

**Received date:** 12 JAN 2022

**Calibration date:** 24 JAN 2022

**Issue date:** 25 JAN 2022

REVIEW BY

*Nirakorn P.*

APPROVED BY

*[Signature]*

NEXT CAL. DATE

27/7/23

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

Relative Humidity:  $(55 \pm 15)\%$

**Calibration Procedure**

The temperature calibration was done by In-House  
calibration method as WI-CL-001 according to com-  
parison method with standard digital temperature indi-  
cator and standard temperature probe. The tempera-  
ture scale use was based on ITS-90.

**Traceability**

The measurement results are traceable to the in-  
ternational system of units (SI) through National Insti-  
tute of Metrology Thailand (NIMT) Certificate number:  
TT-0036-21, Certificate number: ER-0032-21

This Certificate replaces the issued certificate number  
CL-004-65

**Calibrated by**

- ☐ Mr. Sorawit Thachalad  
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

*[Signature]*

Mr. Parinya Booncharoen  
Calibration Department Manager

Certificate No.: CL-004-65  
Page 2 of 2

**Result of Calibration:-** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20-40 °C

**Function:**

This equipment was connected with temperature sensor Model : HMP60 S/N : R1131112

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.053	19.8	-0.3	0.099
60	25.005	24.5	-0.5	0.099
60	29.995	29.5	-0.5	0.099
60	34.976	34.4	-0.6	0.099
60	39.957	39.3	-0.7	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 \***







## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

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

Barometric Pressure (mmHg) : 759  
Relative Humidity (%) : 58.0  
Temperature (°C) : 27.0

### Console Control Meter Data

Calibration No. C-030123-BKK\_FS0507  
Dry Gas Meter ID : 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 (Y) : 1.0000  
Next Calibration Date : 9 Dec 23

$\Delta H$  (mm.H <sub>2</sub> O)	$\Theta$  Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter	Orifice
		Vr (Liters)			Tr  (°C)	Vm (Liters)			Ti  (°C)	To  (°C)	Avg.Tm  (°C)	Correction	Calibration
		Final	Initial	Total		Final	Initial	Total				Factor  (Y)	Factor  $\Delta H@$
15	12.25	150.00	0.00	150.00	30.0	910899.4	910747.0	152.40	33.0	33.0	33.0	0.9926	45.5175
25	9.36	150.00	0.00	150.00	31.0	911111.8	910959.0	152.80	33.0	33.0	33.0	0.9857	44.5829
50	6.56	150.00	0.00	150.00	32.0	911269.4	911117.0	152.40	34.0	34.0	34.0	0.9859	43.9430
100	4.56	150.00	0.00	150.00	32.0	911479.2	911327.0	152.20	34.0	34.0	34.0	0.9825	42.4661
150	3.76	150.00	0.00	150.00	32.0	911650.4	911499.0	151.40	34.0	34.0	34.0	0.9830	43.3091
											Avg.	0.9859	43.9637

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

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm 5.08$  from average .

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

Calibrated by:

Chawalit  
( Mr.chawalit Wongchan )  
Field Scientist(2)

Approved by:

Samart  
( Mr.Samart Roo-ngan )  
Field Specialist(1)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Jan 23	Ambient Temperature (°C)	30
Calibration sheet No. :	C-030123-BKK_FS0508	Relative Humidity (%) :	62
Digital Temperature ID :	BKK_FS0508	Reference Temperature ID	BKK_FS1144
Serial No. :	1503017	Serial No. :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	31 Jan 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	51	1	±3	Pass
	100	101	1	±3	Pass
	150	151	1	±3	Pass
	200	201	1	±3	Pass
	250	252	2	±3	Pass
	300	302	2	±3	Pass
	500	503	3	±3	Pass
Probe	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	100	0	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	100	0	±3	Pass
	120	121	1	±3	Pass
	140	142	2	±3	Pass
Exit	0	1	1	±3	Pass
	10	11	1	±3	Pass
	20	21	1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

Calibrated by : 

( Mr.Prasert Surakhan )

Field Scientist (3)

Approved by : 

( Mr.Samart Roo-ngan )

Specialist (1)



## Stopwatch Calibration Test Report

Calibration Date : 3 Jan 23

Next Cal. Date : 3 Jul 23

Barometric Pressure (mmHg) : 759

Temperature (°C) : 27.0

Relative Humidity (%) : 58.0

### 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	5:00:11	5:00	11	0.00018
2	5:00:12	5:00	12	0.00020
3	5:00:11	5:00	11	0.00018
4	5:00:09	5:00	9	0.00015
5	5:00:07	5:00	7	0.00012
6	5:00:11	5:00	11	0.00018
7	5:00:11	5:00	11	0.00018
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	0.00003

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\_FS0511      Calibration Date : 3 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-030123-BKK\_FS0511      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{C}_p$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Sa P.

( Mr.Samart Roo-ngan)

Specialist (1)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0512      Calibration Date : 3 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-030123-BKK\_FS0512      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{C}_p$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Sa P.

( Mr.Samart Roo-ngan)

Specialist (1)



PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

Calibration Date : 3 Jan 23	Nozzle Set ID. : BKK_FS0513
Calibration Sheet No. : C-030123-BKK_FS0513	Vernier Caliper ID.: RYG_FS0539

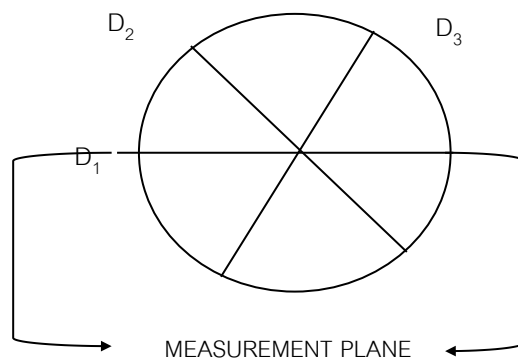
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$	$\Delta D$	$D_{avg}$
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270
8	1.600	1.600	1.600	0.000	1.600

Where :

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

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

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



Calibrated by : \_\_\_\_\_

Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : \_\_\_\_\_

Samart R.

( Mr. Samart Roo-ngan )

Field Specialist (1)



## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

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

Barometric Pressure (mmHg) : 759  
Relative Humidity (%) : 58.0  
Temperature (C°) : 27.0

### Console Control Meter Data

Calibration No. C-030123-BKK\_FS1093  
Dry Gas Meter ID : BKK\_FS1093  
Serial No. : 1706090  
Model No. : XC-572-V

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK\_FS0629  
Serial No. : 1607009  
Correction Factor (Y) : 1.0000  
Next Calibration Date : 9 Dec 23

$\Delta H$  (mm.H <sub>2</sub> O)	$\Theta$  Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter	Orifice
		Vr (Liters)			Tr  (°C)	Vm (Liters)			Ti  (°C)	To  (°C)	Avg.Tm  (°C)	Correction	Calibration
		Final	Initial	Total		Final	Initial	Total				Factor  (Y)	Factor  $\Delta H@$
15	12.40	150.00	0.00	150.00	34.0	302617.0	302468.0	149.00	32.0	32.0	32.0	0.9987	48.0355
25	9.53	150.00	0.00	150.00	34.0	302773.0	302625.0	148.00	32.0	32.0	32.0	1.0045	47.2883
50	6.73	150.00	0.00	150.00	33.0	302935.0	302786.0	149.00	32.0	32.0	32.0	0.9986	46.8591
100	4.71	150.00	0.00	150.00	33.0	303365.0	303217.0	148.00	34.0	34.0	34.0	1.0071	45.6034
150	3.82	150.00	0.00	150.00	33.0	303699.0	303550.0	149.00	35.0	34.0	34.5	0.9972	44.9960
											Avg.	1.0012	46.5565

$\gamma$  : Ratio of reading of reference to dry gas meter : tolerance for individual values  $\pm 0.02$  from average .

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm 5.08$  from average .

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

Calibrated by:

( Mr. Worawich Tongpoom )

Field Scientist(2)

Approved by:

( Mr.Samart Roo-ngan)

Field Specialist(1)





## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Jan 23	Ambient Temperature (°C)	30
Calibration sheet No. :	C-030123-BKK_FS1093	Relative Humidity (%) :	62
Digital Temperature ID :	BKK_FS1093	Reference Temperature ID	BKK_FS1144
Serial No. :	1706090	Serial No. :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	31 Jan 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
	250	249	-1	±3	Pass
	300	299	-1	±3	Pass
	500	498	-2	±3	Pass
Probe	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	141	1	±3	Pass
Oven	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	141	1	±3	Pass
Filter	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

Calibrated by : 

( Mr.Prasert Surakhan )

Field Scientist (3)

Approved by : 

( Mr.Samart Roo-ngan )

Specialist (1)



## Stopwatch Calibration Test Report

Calibration Date : 3 Jan 23

Next Cal. Date : 3 Jul 23

Barometric Pressure (mmHg) : 759

Temperature (°C) : 27.0

Relative Humidity (%) : 58.0

### 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	Calibration Date :	3 Jan 23
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-030123-BKK_FS1104	Cp Standard :	0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{Cp}$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Samart R.

( Mr.Samart Roo-ngan)

Specialist (1)





## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS1105      Calibration Date : 3 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-030123-BKK\_FS1105      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
Test 2	A	12.00	17.20	0.835	-
	B	12.00	17.20	-	0.835
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{C}_p$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Samart P.

( Mr.Samart Roo-ngan)

Specialist (1)



## PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date : 3 Jan 23	Nozzle Set ID. : BKK_FS1093
Calibration Sheet No. : C-030123-BKK_FS1106	Vernier Caliper ID.: RYG_FS0539

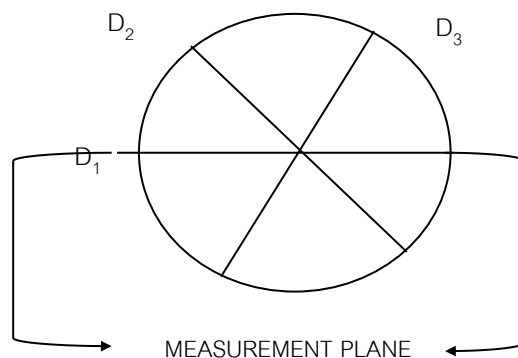
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$	$\Delta D$	$D_{avg}$
1	0.300	0.300	0.300	0.000	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.600	0.600	0.600	0.000	0.600
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.090	1.090	1.090	0.000	1.090
7	1.250	1.250	1.250	0.000	1.250
8	1.600	1.600	1.600	0.000	1.600

Where :

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

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

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



Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Samart R.

( Mr. Samart Roo-ngan )

Field Specialist (1)



## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

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

Barometric Pressure (mmHg) : 759  
Relative Humidity (%) : 58.0  
Temperature (°C) : 27.0

### Console Control Meter Data

Calibration No. C-030123-BKK\_FS0536  
Dry Gas Meter ID : BKK\_FS0536  
Serial No. : 1508054  
Model No. : XC-572-V

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK\_FS0629  
Serial No. : 1607009  
Correction Factor (Y) : 1.0000  
Next Calibration Date : 9 Dec 23

$\Delta H$  (mm.H <sub>2</sub> O)	$\Theta$  Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter	Orifice
		Vr (Liters)			Tr  (°C)	Vm (Liters)			Ti  (°C)	To  (°C)	Avg.Tm  (°C)	Correction	Calibration
		Final	Initial	Total		Final	Initial	Total				Factor  (Y)	Factor  $\Delta H@$
15	12.03	150.00	0.00	150.00	32.0	928922.0	928770.0	152.00	29.0	29.0	29.0	0.9757	45.0678
25	9.21	150.00	0.00	150.00	33.0	929087.0	928935.0	152.00	31.0	31.0	31.0	0.9780	44.0230
50	6.57	150.00	0.00	150.00	33.0	929981.0	929830.0	151.00	32.0	32.0	32.0	0.9854	44.6575
100	4.57	150.00	0.00	150.00	33.0	930176.0	930025.0	151.00	32.0	32.0	32.0	0.9806	43.2142
150	3.75	150.00	0.00	150.00	33.0	930456.0	930305.0	151.00	32.0	32.0	32.0	0.9759	43.6463
											Avg.	0.9791	44.1218

$\gamma$  : Ratio of reading of reference to dry gas meter : tolerance for individual values  $\pm 0.02$  from average .

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm 5.08$  from average .

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

Calibrated by:

Chawalit  
( Mr.chawalit Wongchan )  
Field Scientist(2)

Approved by:

Samart  
( Mr.Samart Roo-ngan )  
Field Specialist(1)





## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Jan 23	Ambient Temperature (°C)	30
Calibration sheet No. :	C-030123-BKK_FS0537	Relative Humidity (%) :	62
Digital Temperature ID :	BKK_FS0537	Reference Temperature ID	BKK_FS1144
Serial No. :	1508054	Serial No. :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	31 Jan 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	199	-1	±3	Pass
	250	249	-1	±3	Pass
	300	299	-1	±3	Pass
	500	498	-2	±3	Pass
Probe	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	21	1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

Calibrated by : 

( Mr.Prasert Surakhan )

Field Scientist (3)

Approved by : 

( Mr.Samart Roo-ngan )

Specialist (1)



## Stopwatch Calibration Test Report

Calibration Date : 3 Jan 23

Next Cal. Date : 3 Jul 23

Barometric Pressure (mmHg) : 759

Temperature (°C) : 27.0

Relative Humidity (%) : 58.0

### 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\_FS0536

Model : XC-572-V

Serial No. : 1924

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:10	5:00	10	0.00017
2	5:00:11	5:00	11	0.00018
3	5:00:09	5:00	9	0.00015
4	5:00:08	5:00	8	0.00013
5	5:00:11	5:00	11	0.00018
6	5:00:10	5:00	10	0.00017
7	5:00:11	5:00	11	0.00018
8	5:00:12	5:00	12	0.00020
9	5:00:12	5:00	12	0.00020
10	5:00:12	5:00	12	0.00020
			Average	0.00018
			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\_FS0540      Calibration Date : 3 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-030123-BKK\_FS0540      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{Cp}$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Samart P.

( Mr.Samart Roo-ngan)

Specialist (1)





## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0541      Calibration Date : 3 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-030123-BKK\_FS0541      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{C}_p$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Sa P.

( Mr.Samart Roo-ngan)

Specialist (1)



**PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET**

Calibration Date : 3 Jan 23	Nozzle Set ID. : BKK_FS0542
Calibration Sheet No. : C-030123-BKK_FS0542	Vernier Caliper ID.: RYG_FS0539

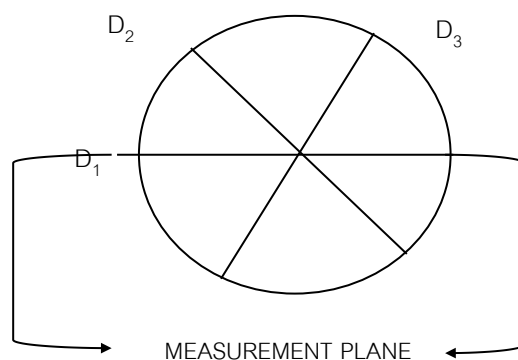
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$	$\Delta D$	$D_{avg}$
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270
8	1.600	1.600	1.600	0.000	1.600

Where :

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

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

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



Calibrated by : \_\_\_\_\_

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : \_\_\_\_\_

( Mr. Samart Roo-ngan )

Field Specialist (1)

**Certificate No:** G 650847

**Date of issue :** 09-Dec-22

**Instrument description :** Flue gas Analyzer  
**Instrument model :** Testo 350 New  
**Instrument serial no. :** 62985022  
**ID no. or control no. :** BKK\_FS1156  
**Manufacturer :** Testo SE & Co. KGaA  
**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-224282  
**Receiving date. :** 07-Dec-22  
**Parameter of calibration :** Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm,  
 Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm,  
 Sulphur Dioxide 50.04,100.8,601.1 ppm)  
**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurement were carried out the stabilized laboratory  
 Temperature : 23 ± 5 °C  
 Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
**Calibration procedure no. :** WI-CL-28-C



*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement  
 Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.  
 This certificate is applied only to item under test Environmental condition.*

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

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

**Date of calibration :** 08-Dec-22



Mr. Sedtawut Nueathong

**Calibration Technician**



Mrs. Nongluck Wongsettee

**Technical Manager**

**Standard References** (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm	2041/22	Linde	26-Jun-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 202.2 ppm	3239/21	Linde	20-Jul-23
Nitric Oxide ( NO ) 30.08 ppm	CG-0089-22	Nimt	13-Jun-24
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide ( NO ) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 601.1 ppm	3204/21	Linde	20-Jul-23

**Measured room conditions**

Temperature : 21.4 °C Humidity : 57.5 %RH Pressure : 1016.2 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1021.6 mbar

**Calibration Results Before Adjustment** (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty ( ± )
O <sub>2</sub> (%Vol)	2.498	2.48	-0.018	0.20
O <sub>2</sub> (%Vol)	10.04	9.94	-0.10	0.40
O <sub>2</sub> (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	309.9	313	3.1	6.0
CO (ppm)	1003	1010	7	12
NO <sub>2</sub> (ppm)	30.34	23.6	-6.74	8.0
NO <sub>2</sub> (ppm)	80.96	63.2	-17.76	8.0
NO <sub>2</sub> (ppm)	202.2	173.6	-28.6	12
NO (ppm)	30.08	27	-3.08	8.0
NO (ppm)	150.9	148	-2.9	8.0
NO (ppm)	320.6	302	-18.6	12
SO <sub>2</sub> (ppm)	50.04	44	-6.04	6.0
SO <sub>2</sub> (ppm)	100.8	96	-4.8	6.0
SO <sub>2</sub> (ppm)	601.1	592	-9.1	13



**Calibration Results After Adjustment (Table 3)**

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.48	-0.018	0.20
O2 (%Vol)	10.04	9.94	-0.10	0.40
O2 (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	309.9	313	3.1	6.0
CO (ppm)	1003	1010	7	12
NO2 (ppm)	30.34	31.1	0.76	8.0
NO2 (ppm)	80.96	82.1	1.14	8.0
NO2 (ppm)	202.2	205.4	3.2	12
NO (ppm)	30.08	29	-1.08	8.0
NO (ppm)	150.9	150	-0.9	8.0
NO (ppm)	320.6	316	-4.6	12
SO2 (ppm)	50.04	50	-0.04	6.0
SO2 (ppm)	100.8	100	-0.8	6.0
SO2 (ppm)	601.1	599	-2.1	13

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

### End of Report

**Certificate No:** G 650809

**Date of issue :** 29-Nov-22

**Instrument description :** Flue gas Analyzer  
**Instrument model :** Testo 340  
**Instrument serial no. :** 63119029  
**ID no. or control no. :** BKK\_FS1158  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial :** -  
**Customer name :** ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
**Customer address :** 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan,

REVIEW BY	Marakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	21/11/23

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**Total pages of certificate :** 3 Pages  
**Receiving no. :** L-224149  
**Receiving date. :** 21-Nov-22  
**Parameter of calibration :** Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.8,601.1 ppm)

**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurement were carried out the stabilized laboratory  
Temperature : 23 ± 5 °C  
Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210

**Calibration procedure no. :** WI-CL-28-C

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

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

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

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

**Date of calibration :** 28-Nov-22

[Signature]

Mr. Sedtawut Nueathong  
Calibration Technician

[Signature]

Mrs. Nongluck Wongsettee  
Technical Manager

**Standard References (Table 1)**

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2583/22	Linde	09-Aug-24
Nitric Oxide ( NO ) 30.08 ppm	CG-0089-22	Nimt	13-Jun-24
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide ( NO ) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 601.1 ppm	3204/21	Linde	20-Jul-23

**Measured room conditions**

Temperature : 23.4 °C Humidity : 54.1 %RH Pressure : 1015.6 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1021.8 mbar

**Calibration Results Before Adjustment (Table 2)**

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty ( ± )
O <sub>2</sub> (%Vol)	2.498	2.44	-0.058	0.20
O <sub>2</sub> (%Vol)	10.04	9.91	-0.13	0.40
O <sub>2</sub> (%Vol)	21.02	21.08	0.06	0.80
CO (ppm)	80.14	85	4.86	3.0
CO (ppm)	309.9	323	13.1	6.0
CO (ppm)	1003	1049	46	12
NO (ppm)	30.08	27	-3.08	8.0
NO (ppm)	150.9	145	-5.9	8.0
NO (ppm)	320.6	298	-22.6	12
SO <sub>2</sub> (ppm)	50.04	41	-9.04	6.0
SO <sub>2</sub> (ppm)	100.8	95	-5.8	6.0
SO <sub>2</sub> (ppm)	601.1	589	-12.1	13



Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.498	2.44	-0.058	0.20
O <sub>2</sub> (%Vol)	10.04	9.91	-0.13	0.40
O <sub>2</sub> (%Vol)	21.02	21.08	0.06	0.80
CO (ppm)	80.14	79	-1.14	3.0
CO (ppm)	309.9	308	-1.9	6.0
CO (ppm)	1003	997	-6	12
NO (ppm)	30.08	30	-0.08	8.0
NO (ppm)	150.9	151	0.1	8.0
NO (ppm)	320.6	311	-9.6	12
SO <sub>2</sub> (ppm)	50.04	48	-2.04	6.0
SO <sub>2</sub> (ppm)	100.8	100	-0.8	6.0
SO <sub>2</sub> (ppm)	601.1	605	3.9	13

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

### End of Report

## MULTI POINT CALIBRATION REPORT

REVIEW BY Vichuta N.APPROVED BY Sararat M.

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co.Ltd.

EQUIPMENT NAME : CO Analyzer

NEXT CAL. DATE 7 Oct 23

MANUFACTURER : Teledyne - API

MODEL : T300

SERIAL NO : 1756

STANDARD GAS CONCENTRATION (PPM) : 4512

CYLINDER NO : CC745169

CYLINDER PRESSURE (psig) : 1900

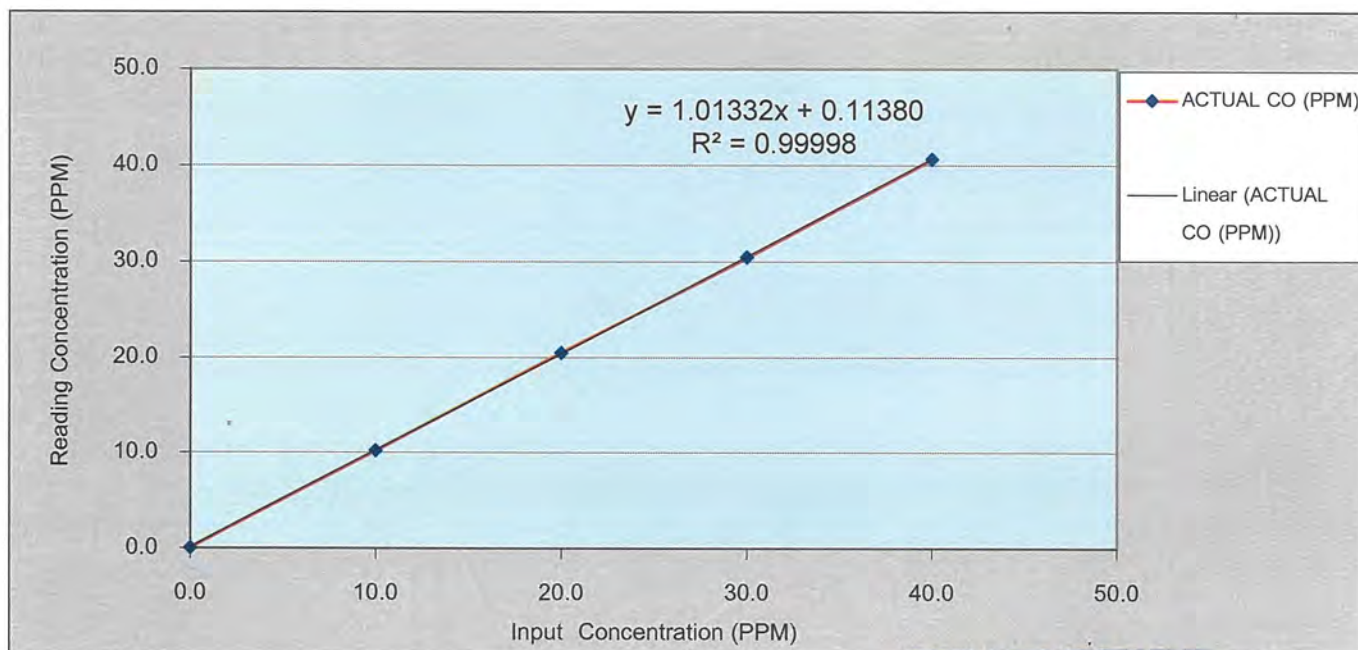
CERTIFIED DATE : Mar 10, 2021

CERTIFIED BY : AIRGAS SPECIALTY GASES

EXPIRED DATE : Mar 10, 2029

## CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL (PPM)	ACTUAL CO (PPM)	ERROR CO (PPM)	% ERROR CO
ZERO	0.0	0.065	0.065	-
1	10.0	10.238	0.238	2.380
2	20.0	20.514	0.514	2.570
3	30.0	30.468	0.468	1.560
4	40.0	40.616	0.616	1.540
AVERAGE (%)				2.012

**KINETICS**  
บริษัท ไคเนติกส์ คอร์ปอเรชั่น จำกัด

CALIBRATED BY : คุณพรชัย ผาติวนารักษ์

DATE : 7 เมษายน 2565

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : คุณพรชัย ผาติวนารักษ์ โทรศัพท์ : 02-515-8987





## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

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

Barometric Pressure (mmHg) : 759  
Relative Humidity (%) : 58.0  
Temperature (°C) : 27.0

### Console Control Meter Data

Calibration No. C-030123-BKK\_FS0547  
Dry Gas Meter ID : BKK\_FS0547  
Serial No. : 1606040  
Model No. : XC-572-V

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK\_FS0629  
Serial No. : 1607009  
Correction Factor (Y) : 1.0000  
Next Calibration Date : 9 Dec 23

$\Delta H$  (mm.H <sub>2</sub> O)	$\Theta$  Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter	Orifice
		Vr (Liters)			Tr  (°C)	Vm (Liters)			Ti  (°C)	To  (°C)	Avg.Tm  (°C)	Correction	Calibration
		Final	Initial	Total		Final	Initial	Total				Factor  (Y)	Factor  $\Delta H@$
15	12.56	150.00	0.00	150.00	26.0	448155.0	448007.0	148.00	28.0	28.0	28.0	1.0188	47.3694
25	9.51	150.00	0.00	150.00	26.0	448312.8	448165.0	147.80	28.0	28.0	28.0	1.0192	45.2614
50	6.68	150.00	0.00	150.00	27.0	448467.4	448320.0	147.40	29.0	29.0	29.0	1.0195	44.8136
100	4.70	150.00	0.00	150.00	27.0	448623.4	448477.0	146.40	30.0	30.0	30.0	1.0249	44.2228
150	3.86	150.00	0.00	150.00	28.0	448780.4	448634.0	146.40	31.0	31.0	31.0	1.0200	44.8928
											Avg.	1.0205	45.3120

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

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm 5.08$  from average .

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

Calibrated by:

Chawalit  
( Mr.chawalit Wongchan )  
Field Scientist(2)

Approved by:

Samart  
( Mr.Samart Roo-ngan )  
Field Specialist(1)



## Stopwatch Calibration Test Report

Calibration Date : 3 Jan 23      Next Cal. Date : 3 Jul 23  
Barometric Pressure (mmHg) : 759      Temperature (°C) : 27.0  
Relative Humidity (%) : 58.0

### 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\_FS0547  
Model : XC-572-V  
Serial No. : 1606040

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	5:00:11	5:00	11	0.00018
3	5:00:09	5:00	9	0.00015
4	5:00:11	5:00	11	0.00018
5	5:00:12	5:00	12	0.00020
6	5:00:12	5:00	12	0.00020
7	5:00:12	5:00	12	0.00020
8	5:00:11	5:00	11	0.00018
9	5:00:10	5:00	10	0.00017
10	5:00:09	5:00	9	0.00015
			Average	0.00018
			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 Jan 23	Ambient Temperature (°C)	30
Calibration sheet No. :	C-030123-BKK_FS0548	Relative Humidity (%) :	62
Digital Temperature ID :	BKK_FS0548	Reference Temperature ID	BKK_FS1144
Serial No. :	1606040	Serial No. :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	31 Jan 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	51	1	±3	Pass
	100	102	2	±3	Pass
	150	152	2	±3	Pass
	200	202	2	±3	Pass
	250	252	2	±3	Pass
	300	302	2	±3	Pass
	500	502	2	±3	Pass
Probe	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	142	2	±3	Pass
Oven	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	142	2	±3	Pass
Filter	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	142	2	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	21	1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	51	1	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	51	1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

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\_FS0551      Calibration Date : 3 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-030123-BKK\_FS0551      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{C}_p$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Sa P.

( Mr.Samart Roo-ngan)

Specialist (1)



## Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS0552	Calibration Date :	3 Jan 23
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-030123-BKK_FS0552	Cp Standard :	0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
				$\bar{C}_p$	0.842
				0.842	0.842

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

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

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

Calibrated by : Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : Sa P.

( Mr.Samart Roo-ngan)

Specialist (1)





PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

Calibration Date : 3 Jan 23	Nozzle Set ID. : BKK_FS0547
Calibration Sheet No. : C-030123-BKK_FS0553	Vernier Caliper ID.: RYG_FS0539

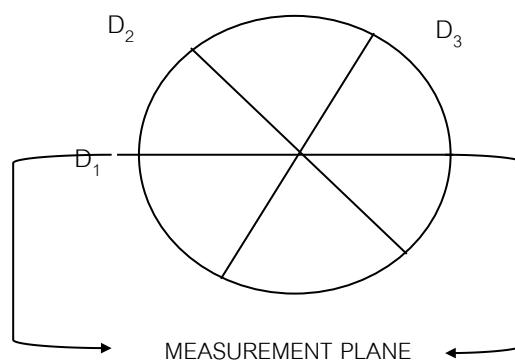
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$	$\Delta D$	$D_{avg}$
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270
8	1.600	1.600	1.600	0.000	1.600

Where :

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

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

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



Calibrated by : \_\_\_\_\_

Worawich T.

( Mr. Worawich Tongpoom )

Field Scientist (2)

Approved by : \_\_\_\_\_

Sa P.

( Mr. Samart Roo-ngan )

Field Specialist (1)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No. 23-65/0497-03

MTC.No. 23-65/0497-03

Number of Pages(S) 2

## CALIBRATION CERTIFICATE

**Nomenclature :** " P " VACCUUM GAUGE

Model : F221AVD

Serial No. : VG06 ID. BKK\_FS0896

Range : -30 in Hg to 0 in Hg

Scale Interval : 0.5 in Hg

**Submitted by :** ALS Laboratory Group ( Thailand ) Co., Ltd.

104 Phatthanakan 40, Phattanakan Rd.,

Khwaeng Phattanakan, Khet Suan Luang, Bangkok 10250, Thailand.

**Calibration method :** Normal

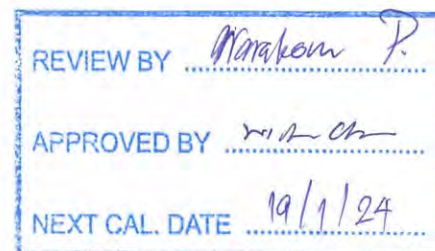
**Received date :** 7 June 2022

**Calibration date :** 21 July 2022

**Standard :** Reference Pressure Monitor, Serial 1950, Certificate no. 23-64/0581-01

Due Date 3 August 2022

The Standard used for the measurement is traceable to SI Unit through  
National Institute of Metrology (THAILAND).



**CALIBRATED BY :** 

( Mr.Uthai Chaiyapat )

**APPROVED BY :** 

( Ms.Kirana Luanghirun )

Director

**Mechanical Engineering Standards Laboratory**

Ref. 2013265060702513003

Issued Date : 22 July 2022

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FM.BL.MTC.002 Rev.4

**Head Office**

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
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**Office/Laboratory**

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

**Office**

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Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)  
Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Reques 23-65/0497-03

2 / 2

MTC.No. 23-65/0497-03

**Calibration range** : -27 in Hg to 0 in Hg

**Calibration method** : The Vacuum Gauge Under Calibration (UUC) was calibrated by comparison method followed DAkKS-DKD-R 6-1: Calibration of Pressure Gauge, edition 03/2014

**Calibration condition** : Temperature (  $23.4 \pm 2$  ) ° C , Relative Humidity (  $66 \pm 10$  ) %  
Atmospheric pressure (  $1001 \pm 10$  ) hPa,  
Local gravity (  $9.783003 \pm 0.000050$  ) m/s<sup>2</sup>

**Measurement Data :**

Gauge position : Vertical

Medium : Air

Reference level : Gauge inlet

Unit : in Hg


UUC Reading	Gauge Pressure	Error	(±) Uncertainty
0	0.00	0.00	0.12
-10	-9.82	-0.18	0.14
-20	-19.95	-0.05	0.12
-26	-26.08	0.08	0.12
-27	-27.05	0.05	0.12
-28	-28.06	0.06	0.12

Note : 1. The reading taken after the gauge is lightly tapped.

2. Conversion factor : in Hg = 3.386384 kPa

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

**The End of Calibration Certificate**



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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)  
Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No. 23-65/0497-02

MTC.No. 23-65/0497-02

Number of Pages(S) 2

## CALIBRATION CERTIFICATE

**Nomenclature :** " P " VACCUUM GAUGE

Model : F221AVD

Serial No. : VG04 ID. BKK\_FS0894

Range : -30 in Hg to 0 in Hg

Scale Interval : 0.5 in Hg

**Submitted by :** ALS Laboratory Group ( Thailand ) Co., Ltd.

104 Phatthanakan 40, Phattanakan Rd.,

Khwaeng Phattanakan, Khet Suan Luang, Bangkok 10250, Thailand.

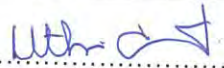
**Calibration method :** Normal

**Received date :** 7 June 2022

**Calibration date :** 21 July 2022

**Standard :** Reference Pressure Monitor, Serial 1950, Certificate no. 23-64/0581-01  
Due Date 3 August 2022

The Standard used for the measurement is traceable to SI Unit through  
National Institute of Metrology (THAILAND).

**CALIBRATED BY :**   
( Mr.Uthai Chaiyapat )

**APPROVED BY :**   
( Ms.Kirana Luanghirun )

Director

**Mechanical Engineering Standards Laboratory**

Ref. 2013265060702513002

Issued Date : 22 July 2022

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)  
Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Reques 23-65/0497-02

2 / 2

MTC.No. 23-65/0497-02

**Calibration range** : -27 in Hg to 0 in Hg

**Calibration method** : The Vacuum Gauge Under Calibration (UUC) was calibrated by comparison method followed DAKKS-DKD-R 6-1: Calibration of Pressure Gauge, edition 03/2014

**Calibration condition** : Temperature (  $23.4 \pm 2$  ) °C , Relative Humidity (  $66 \pm 10$  ) %  
Atmospheric pressure (  $1001 \pm 10$  ) hPa,  
Local gravity (  $9.783003 \pm 0.000050$  ) m/s<sup>2</sup>

**Measurement Data :**

Gauge position : Vertical

Medium : Air

Reference level : Gauge inlet

Unit : in Hg

UUC Reading	Gauge Pressure	Error	(±) Uncertainty
0	0.00	0.00	0.12
-10	-9.82	-0.18	0.21
-20	-20.09	0.09	0.23
-26	-26.33	0.33	0.13
-27	-27.27	0.27	0.18
-28	-28.34	0.34	0.12

Note : 1. The reading taken after the gauge is lightly tapped.

2. Conversion factor : in Hg = 3.386384 kPa

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

**The End of Calibration Certificate**



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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No. 23-65/0316-03

MTC.No. 23-65/0316-03

Number of Pages(S) 2

## CALIBRATION CERTIFICATE

**Nomenclature :** " P " VACCUUM GAUGE

Model : F221AVD

Serial No. : VG05 ID. BKK\_FS0895

Range : -30 in Hg to 0 in Hg

Scale Interval : 0.5 in Hg

**Submitted by :** ALS Laboratory Group ( Thailand ) Co., Ltd.

104 Phatthanakan 40, Phattanakan Rd.,

Khwaeng Phattanakan, Khet Suan Luang, Bangkok 10250, Thailand.

**Calibration method :** Normal

**Received date :** 17 March 2022

**Calibration date :** 10 May 2022

**Standard :** Reference Pressure Monitor, Serial 1950, Certificate no. 23-64/0581-01

Due Date 3 August 2022

The Standard used for the measurement is traceable to SI Unit through  
National Institute of Metrology (THAILAND).



**CALIBRATED BY :**

( Mr.Uthai Chaiyapat )

**APPROVED BY :**

( Ms.Kirana Luanghirun )

Director

**Mechanical Engineering Standards Laboratory**

Ref. 2013265031701244003

Issued Date : 12 May 2022

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Reques 23-65/0316-03

2 / 2

MTC.No. 23-65/0316-03

**Calibration range** : -27 in Hg to 0 in Hg

**Calibration method** : The Vacuum Gauge Under Calibration (UUC) was calibrated by comparison method followed DAKK S-DKD-R 6-1: Calibration of Pressure Gauge, edition 03/2014

**Calibration condition** : Temperature (  $23.3 \pm 2$  ) °C , Relative Humidity (  $60 \pm 10$  ) %  
Atmospheric pressure (  $1005 \pm 10$  ) hPa,  
Local gravity (  $9.783003 \pm 0.000050$  ) m/s<sup>2</sup>

**Measurement Data :**

Gauge position : Vertical

Medium : Air


Reference level : Gauge inlet

Unit : in Hg

UUC Reading	Gauge Pressure	Error	(±) Uncertainty
0	0.00	0.00	0.12
-10	-8.57	-1.43	0.12
-20	-18.49	-1.51	0.13
-26	-24.57	-1.43	0.12
-27	-25.50	-1.50	0.13
-28	-26.44	-1.56	0.12

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

**The End of Calibration Certificate**



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E-mail : sumalee@tistr.or.th

# Certificate of Calibration

Number of Page(s) 1 of 3

**Certificate No.** BSCC-UV-307/22  
**Equipment** UV/Vis Spectrophotometer  
**Model** UV-1800  
**Manufacturer** Shimadzu  
**Serial No.** A11454908533CD  
**ID No.** BKK\_EN0018  
**Date of receipt** 16 September 2022  
**Date of calibration** 16 September 2022  
**Date of issue** 23 September 2022

REVIEW BY *Siriluk P.*  
APPROVED BY *Kw An*  
16/9/23  
NEXT CAL. DATE *23/9/22*

**Customer name** ALS Laboratory Group (Thailand) Co., Ltd.

**Address** 104 Soi Phatthanakan 40, Phatthanakan Road, Phatthanakan, Suan Luang, Bangkok 10250

**Temperature** (22.1-23.3) °C (On site)

**Humidity** (58.8-63.2) %RH (On site)

**Equipment condition** Good Operation

**Calibration Location** Organic Prep

**Calibration Procedure** In-house method WI-UV-702-01 based on ASTM E275-01

**Traceability** Wavelength Accuracy is traceable to certificate No. 95917 and 95918  
Photometric Accuracy is traceable to certificate No. 95924 and 95937  
Stray Light is traceable to certificate No. 95908  
The above certificate are traceable to SI unit through Starna Scientific Ltd.  
(UKAS accredited calibration laboratory NO. 0659)

**Calibrated by** Mr.Waruth Janphung

Approved by



**Mr.Kanchit Choothep**  
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced  
except in full, without written approval of the Bara Scientific Co., Ltd.

# Certificate of Calibration

Certificate No.

BSCC-UV-307/22

Number of Page(s)

2 of 3

## Calibration Results:

### 1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty ( $\pm$ nm)
241.70	241.65	-0.05	0.18
334.02	333.92	-0.10	0.18
418.53	418.46	-0.07	0.18
572.99	572.96	-0.03	0.18
879.41	879.17	-0.24	0.18

### 2.Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty ( $\pm$ A)
235	0.0000	0.0000	0.0000	0.0075
	0.7467	0.7461	-0.0006	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8647	-0.0015	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2911	0.0007	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6429	0.6426	-0.0003	0.0075

\*CNR = Customer not request

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# Certificate of Calibration

Certificate No. **BSCC-UV-307/22**

Number of Page(s)

3 of 3

## Calibration Results:

### 3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty ( $\pm A$ )
420.0	0.0000	0.0000	0.0000	0.0042
	0.5783	0.5777	-0.0006	0.0042
	0.7628	0.7635	0.0007	0.0046
	1.0206	1.0230	0.0024	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5618	-0.0003	0.0042
	0.7455	0.7460	0.0005	0.0048
	0.9985	1.0005	0.0020	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5219	-0.0008	0.0042
	0.6880	0.6884	0.0004	0.0051
	0.9487	0.9503	0.0016	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5199	-0.0008	0.0042
	0.6973	0.6971	-0.0002	0.0049
	0.9959	0.9964	0.0005	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5534	-0.0010	0.0042
	0.7253	0.7242	-0.0011	0.0050
	1.0942	1.0943	0.0001	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5606	-0.0010	0.0042
	0.6927	0.6921	-0.0006	0.0053
	1.0881	1.0885	0.0004	0.0042

\*CNR = Customer not request

### 4. Stray Light\*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC)		
	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.96 $\pm$ 0.11nm	200.30	0.9505	2.0229

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

\*Stray Light not NSC-ONSC Accredited.

The measurement uncertainty is base on a standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

**\*\*\*End of Certificate\*\*\***

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
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except in full, without written approval of the Bara Scientific Co., Ltd.



## Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22071

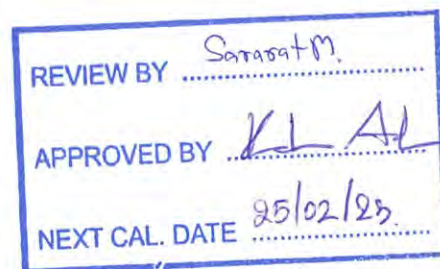
Certificate No.:	PTC/07/22071	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	26207042
Model:	MSE224-100-DU	ID No:	BKK_EN0002
Type of Balance:	Single interval		



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/m<sup>3</sup>

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 Kerdtto )

Laboratory Manager

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

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

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



Represent to Certificate of Calibration ,PTC/07/22071

Certificate No.: PTC/07/22071

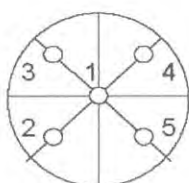
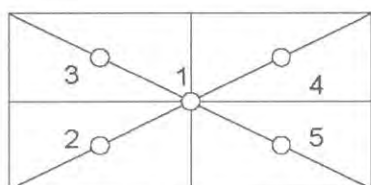
Page: 2 of 2

### 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  $1/2 \leq L_1 \leq$  Maximum capacity

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

Nominal test value (g)	Standard Deviation
200	0.00005

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

**Sartorius (Thailand) Co., Ltd.**

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6, e-mail: service.thailand@sartorius.com



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**

# Certificate

## of Calibration

REVIEW BY	<u>Sirilut P.</u>
APPROVED BY	<u>LL AL</u>
NEXT CAL. DATE	<u>8/2/24</u>

Model Number : MSE224S-100-DUDescription : Analytical BalanceSerial Number : 26207042ID No. : BKK\_EN0002Manufacturer : SartoriusCertificate No. : 23BCI0072Issued Date : Monday, February 13, 2023Reference No. : 203245Page No. : 1 of 2Customer Name : ALS Laboratory Group (Thailand)Co., Ltd.104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250.Calibrated Place : Balance RoomCalibrated By : Mr. Chonchai InthanaCalibration Date : Wednesday, February 08, 2023

Calibration

Procedure No. : This calibration was conducted by  
Using in-house calibration procedure number (WI-003)

Based on UKAS LAB 14 : 2019

**Metrological data :**Capacity : 220 g Readability : 0.0001 g**Ambients Conditions:**Temperature : 23.2 °C ± 5.0 °CHumidity : 60.0 % RH ± 10.0 % RHPressure :                      ±                     **Reasons for calibration**☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ MaintenanceEquipment Condition: ☒ Good Operate ☐ Fair**Measurement Method****UKAS Publication Ref :Lab 14**

The measurement uncertainty stated is the expended uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

**Traceability:**

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

This certificate relate and apply this equipment only.

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

SOP FM 33 03 February 2022

Mr. Chonchai Inthana (Technical Manager)

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T  
A  
M  
P

**Sartorius (Thailand) Co., Ltd.**

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate of Calibration

Model Number : MSE224S-100-DUCertificate No. : 23BCI0072Description : Analytical BalanceIssued Date : Monday, February 13, 2023Serial Number : 26207042Reference No. : 203245ID No. : BKK\_EN0002Manufacturer : SartoriusPage No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

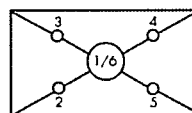
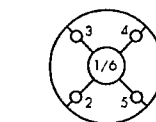
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)	20.0000	200.0000
20 g	20.0000	199.9999
Tolerance	20.0000	200.0000
0.0001 g	20.0000	199.9999
	20.0001	200.0000
Nominal Value : (High Load)	20.0000	200.0000
200 g	20.0000	199.9999
Tolerance	20.0000	199.9999
0.0001 g	20.0000	200.0000
	20.0001	199.9999
Standard Deviation	0.00004	0.00005

### Eccentricity (Off-center loading error)

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

Nominal value : 50 g  
Tolerance 0.0004 g



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

### Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
2	2.0000	2.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	199.9999	-0.0001	0.00030

End of Report.



# 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	Thitima B.
APPROVED BY	Sauntan N.
NEXT CAL. DATE	12 Mar 23

Date: September 13, 2021 5:49:11 PM  
System ID: MY16010005

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### Spectrometer 1

Manufacturer	Agilent Technologies
Name	5100 SVDV
Model Number	G8010A
Sample Introduction	Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number	MY16010005
Firmware Revision	5395

#### Chiller 1

Manufacturer	Agilent Technologies
Name	Other Unspecified
Other Unspecified Name	Chiller
Model Number	Other Unspecified
Other Unspecified Model Number	G3292-80201
Serial Number	2008-00159

#### Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15440764

#### Switching Valve Accessory 1

Manufacturer	Agilent Technologies
Name	SVS 2+
Model Number	G8485A
Serial Number	AU16040115

## 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:	Kanyakorn Sukpathrajarearn
Logged On User Name:	phimprapha.jeeraphong@agilent.com
Signature Creation Date:	September 13, 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.

### Warranty

Agilent Technologies makes no warranty of any kind to this material, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

User Name: phimpapha.jeeraphong  
 Hostname: ASBKWX328

System Id: MY16010005  
 Print Date: September 13, 2021 5:49:12 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 8:49:59 AM	Audit	SessionCreated	Session	None
September 8, 2021 8:49:59 AM	Start	Configuration	Session	None
September 8, 2021 8:49:59 AM	Audit	Entitlement	Licensing	User Is FieldEngineer and does not require an unlock code
September 8, 2021 9:07:06 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended]
September 8, 2021 9:07:11 AM	End	Configuration	Session	None
September 8, 2021 9:07:15 AM	Start	Qualification	Session	OQ
September 8, 2021 9:07:15 AM	Start	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:34:35 AM	End	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:34:39 AM	Start	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:27 AM	End	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1

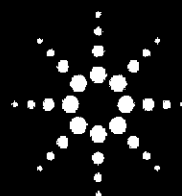


User Name: phimprapha.jeeraphong  
Hostname: ASBKKWX328

System Id: MY16010005  
Print Date: September 13, 2021 5:49:12 PM

## OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 9:51:30 AM	Start	Execution	Autosampler Operation : Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:36 AM	End	Execution	Autosampler Operation : Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:51:38 AM	End	Qualification	Session	OQ
September 8, 2021 9:51:38 AM	Start	Reporting	Session	None
September 8, 2021 10:55:40 AM	Audit	AceClosed	Session	None
September 13, 2021 5:01:26 PM	Audit	AceRestarted	Session	None
September 13, 2021 5:01:26 PM	Audit	SessionReloaded	Session	None
September 13, 2021 5:01:28 PM	Start	Qualification	Session	OQ
September 13, 2021 5:47:55 PM	Audit	Reporting	Session	Report Generated : Certificate



Agilent CrossLab Compliance Services

Agilent  
**CrossLab**  
From Insight to Outcome

## EQUIPMENT QUALIFICATION REPORT (EQR)

### Agilent CrossLab Compliance

Qualification Type:	ES-OQ
System ID:	MY16010005
EQP Name:	AgilentRecommended
EQP Details:	Agilent Technologies System
EQP Revision:	ES.02.50
EQP Release Date:	March 2020
Date:	September 13, 2021 5:50:41 PM
Report Type:	Report
Org. Name:	ALS Laboratory Group (Thailand) Co., Ltd.
Org. Location:	104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

# Table of Contents

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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
Preparation : 5100 SVDV	Pass	1
Instrument Tests : 5100 SVDV	Pass	1
Autosampler Operation : Autosampler 1 - SPS4	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: 6004823273  
EQP Name: AgilentRecommended  
EQP Revision: ES.02.50  
Report Type: Report

### Organization Details

Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

### Local Contact Details

Name: Khun Thitima Boonpeng  
Job Title: Scientist 2, Life Sciences  
Qualification Location: ICP Room

### Operator Details

Name: Kanyakorn sukpathrajareem  
Job Title: Field Service Engineer

### Data Acquisition Details

Acquisition Software Name: ICP Expert  
Acquisition Software Revision: 7.5.3.11953

Customer Data System (CDS): Es: ICP Expert

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### Spectrometer 1

Manufacturer	Agilent Technologies
Name	5100 SVDV
Model Number	G8010A
Sample Introduction	Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number	MY16010005
Firmware Revision	5395

#### Chiller 1

Manufacturer	Agilent Technologies
Name	Other Unspecified
Other Unspecified Name	Chiller
Model Number	Other Unspecified
Other Unspecified Model Number	G3292-80201
Serial Number	2008-00159

#### Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15440764

#### Switching Valve Accessory 1

Manufacturer	Agilent Technologies
Name	SVS 2+
Model Number	G8485A
Serial Number	AU16040115

## 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
ES.02.50	Autosampler Operation
ES.02.50	Instrument Tests
ES.02.50	Preparation

## Preparation

### Purpose

This test records a status for each preparation task for the Agilent ICP-OES.

### Configuration Details

Model/Serial No.:

G8010A

MY16010005

### Results

Criteria

Observed Result

Expected Result

Status

Does the plasma ignite successfully in the first three attempts?

Yes

Yes

Pass

Was the detector calibration performed and completed successfully?

Yes

Yes

Pass

Was the instrument calibration performed and completed successfully?

Yes

Yes

Pass

## Test Evidence

Image Details:

Was the detector calibration performed and completed successfully?

Date and Time:

September 8, 2021 9:07:42 AM

Host Name:

ASBKKWX328

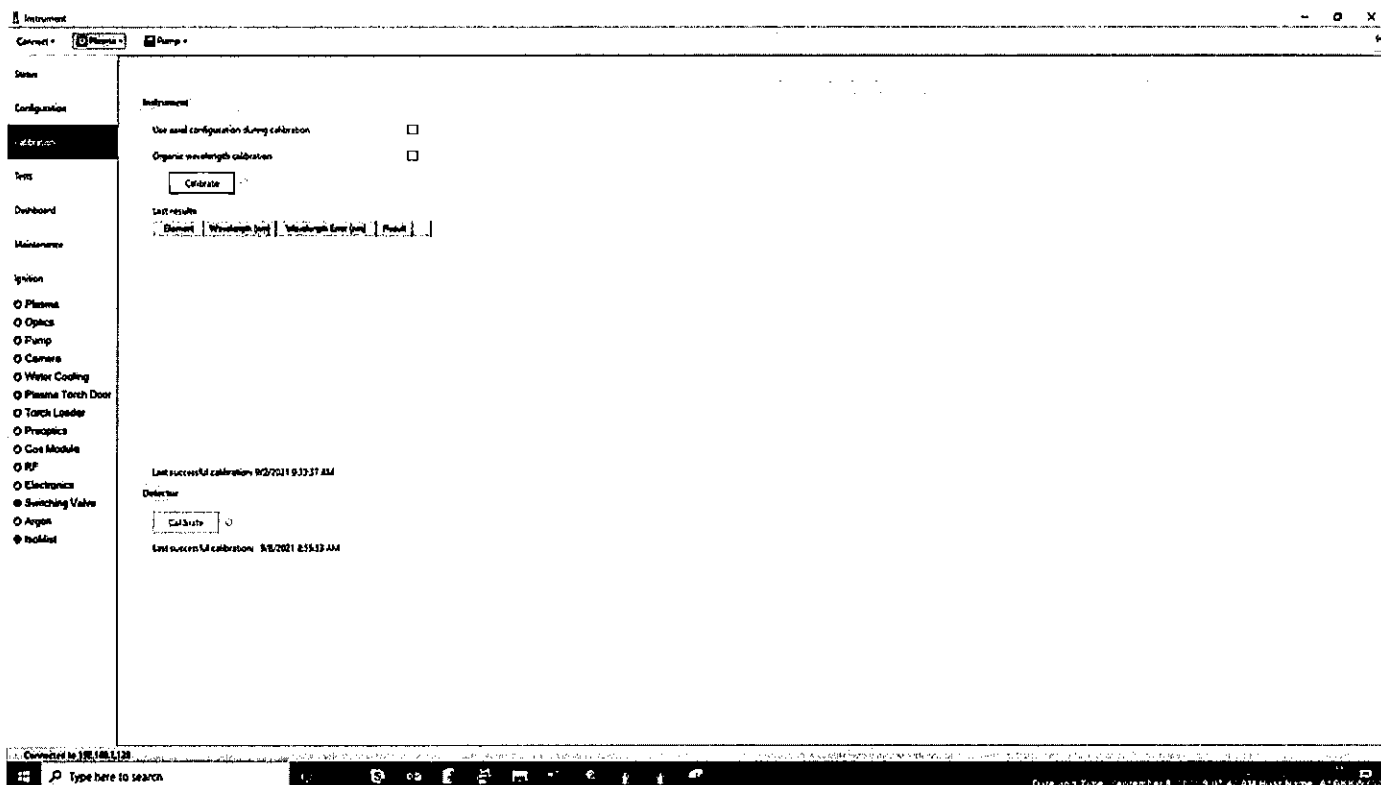




Image Details:

Was the instrument calibration performed and completed successfully?

Date and Time:

September 8, 2021 9:33:30 AM

Host Name:

ASBKKWX328

The screenshot displays the 'Instrument' configuration window. On the left, a sidebar lists various components: Plasma, Optics, Pump, Camera, Water Cooling, Plasma Torch Door, Torch Loader, Preoptics, Gas Module, RF, Electronics, Switching Valve, and Argon. The 'Plasma' component is selected. The main window shows the 'Instrument' configuration for 'Plasma 1'. It includes checkboxes for 'Use axial configuration during calibration' (checked) and 'Organic wavelength calibration' (unchecked). Below these is a 'Calculate' button. The 'Last results' section contains a table with columns: Element, Wavelength (nm), Wavelength Error (nm), and Result. The table lists 14 elements: Al, H, As, C, Se, Mn, Zn, Mo, Cr, Zn, Cd, Pb, and their respective wavelengths, errors, and results. The 'Result' column shows 'Pass' for all elements. Below the table, it states 'Last successful calibration: 9/8/2021 9:33:07 AM'. The 'Detector' section has a 'Calculate' button and 'Last successful calibration: 9/8/2021 8:55:33 AM'. The bottom status bar shows 'Connected to 192.168.1.128' and 'Type here to search'.

Element	Wavelength (nm)	Wavelength Error (nm)	Result
Al	187.019	0.008347	Pass
H	174.213	0.001644	Pass
As	186.94	-0.001437	Pass
C	193.017	0.003076	Pass
Se	193.096	0.002620	Pass
Mn	195.016	0.004831	Pass
Mn	202.032	-0.000304	Pass
Zn	202.543	-0.006679	Pass
Mo	203.848	0.004706	Pass
Mo	254.596	0.002782	Pass
Cr	205.36	-0.002789	Pass
Zn	213.857	-0.004794	Pass
Cd	214.439	-0.006227	Pass
Pb	220.353	-0.005075	Pass

## Overall Test Status

Pass

Runs: 1

## Instrument Tests

### Purpose

This test records a status for each of the automated tests within the Agilent ICP-OES CDS. For detailed test criteria, refer to the attached report.

### Configuration Details

Model/Serial No.:

G8010A

MY16010005

### Results

Observed Result

Expected Result

Status

Are the Functional Tests results within acceptance criteria?

Subsystem Communications

Yes

Yes

Pass

Air Flow

Yes

Yes

Pass

Water Flow

Yes

Yes

Pass

Gas Flows

Yes

Yes

Pass

RF Generator

Yes

Yes

Pass

Camera

Yes

Yes

Pass

Optics

Yes

Yes

Pass

Are the Instrument Performance Tests results within acceptance criteria?

Resolution

Yes

Yes

Pass

Sensitivity

Yes

Yes

Pass

Precision

Yes

Yes

Pass

### Overall Test Status

Pass

Runs: 1

# Autosampler Operation

## Purpose

This test verifies that the autosampler operates properly.

## Configuration Details

Model/Serial No.:	G8410A	AU15440764
-------------------	--------	------------

## Results

Criteria	Observed Result	Expected Result	Status
Does the autosampler successfully move to the specified location(s)?	Yes	Yes	Pass

## Overall Test Status

Pass	Runs: 1
------	---------

## 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

Location	Category	Document Name	Page
EQR	General	Certificate of Qualification for ACE	1
EQR	General	Certificate of Qualification for ACE	1
EQR	General	Operator's training certificate and qualifications	1
EQR	Material	Certificate of Analysis Wavelength calibration solution	4
EQR	Comments	General	1
EQR	General	Instrument's Test Report	5
EQR	General	Instrument's Test Report	4



## General

Document Name:

Certificate of Qualification for ACE

**Agilent Compliance Engine Self Qualification**

Date: September 8, 2021 10:10:10 AM

Drive Serial #: EAF04572

Platform Revision:

A.03.01

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
UV-Vis Spectrophotometer	13	Conforms
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Software	6	Conforms
Emission Spectroscopy	3	Conforms
Infrared Spectroscopy	7	Conforms

**Overall Qualification Status**

Conforms

## General

Document Name: Certificate of Qualification for ACE



## Certificate of Completion

Learner Name: Kanyakorn Sukpathrajarearn

Title Of Course: AN-CE-SS-II-030-A: ACE 3.X User Update Training

Completion Date: June 25, 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:** Operator's training certificate and qualifications

## Certificate of Completion

**Learner Name:** Kanyakorn Sukpathrajarearn**Title Of Course:** ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training**Completion Date:** November 2, 2017**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.

## Materials

Document Name:

Certificate of Analysis Wavelength calibration solution



# **CERTIFICATE OF ANALYSIS**

**Agilent Product Name:** Wavelength Calibration Solution for ICP-OES & MP-AES, 5 mg/L, 500mL

**Agilent Part No:** 8610030100

**Lot No:** 0010578941

**Product Specifications**

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO <sub>3</sub> ) <sub>3</sub>	7784-27-2	5.000 ± 0.025 mg/L	Mn	Mn	7439-96-5	5.001 ± 0.025 mg/L
As	As	7440-38-2	5.001 ± 0.025 mg/L	Mo	(NH <sub>4</sub> ) <sub>2</sub> MoO <sub>4</sub>	13106-76-8	5.007 ± 0.025 mg/L
Ba	Ba(NO <sub>3</sub> ) <sub>2</sub>	10022-31-8	5.000 ± 0.025 mg/L	Ni	Ni	7440-02-0	5.004 ± 0.025 mg/L
Cd	Cd	7440-43-9	5.002 ± 0.025 mg/L	Pb	Pb	7439-92-1	4.999 ± 0.025 mg/L
Co	Co	7440-48-4	4.996 ± 0.025 mg/L	Se	Se	7782-49-2	5.004 ± 0.025 mg/L
Cr	Cr(NO <sub>3</sub> ) <sub>3</sub>	13548-38-4	5.002 ± 0.025 mg/L	Sr	Sr(NO <sub>3</sub> ) <sub>2</sub>	10042-76-9	5.000 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.007 ± 0.025 mg/L	Zn	Zn	7440-66-8	5.002 ± 0.025 mg/L
K	KNO <sub>3</sub>	7757-79-1	50.00 ± 0.25 mg/L				

**Matrix:** 5% HNO<sub>3</sub>

**Intended Use:** This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectroscopy (MP-AES), x-ray fluorescence spectroscopy (XRF), and other techniques for elemental analysis.

**Certification & Traceability:** This CRM was manufactured under a quality management system that is registered to ISO 9001, ISO 17024 and ISO/IEC 17025. This CRM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to the NIST SRMs listed below. This solution was stabilized using high purity nitric acid (HNO<sub>3</sub>) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against NIST SRMs: 3101a, 3103a, 3104a, 3108, 3113, 3112a, 3114, 3141a, 3132, 3134, 3136, 3128, 3149, 3153a, and 3168a. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

**Instructions for Use:** Agilent recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transferware, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 500µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

**Date:**  
**System ID:**

 September 13, 2021 5:50:41 PM  
 MY16010005

Document Name: Certificate of Analysis Wavelength calibration solution



**Period of Validity:** Agilent ensures the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

Date of release: 6 April 2020  
Date of expiration: 6 October 2021

Sample lot approval:

A handwritten signature in black ink, appearing to read "Chuck Goudreau".

Chuck Goudreau, Certifying Officer



Document Name: Certificate of Analysis Wavelength calibration solution



**Hazard Information:** Refer to the Safety Data Sheet (SDS), which can be obtained at [www.agilent.com/chem/sds](http://www.agilent.com/chem/sds).

**Homogeneity:** This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with QSP 8-13 Assessment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

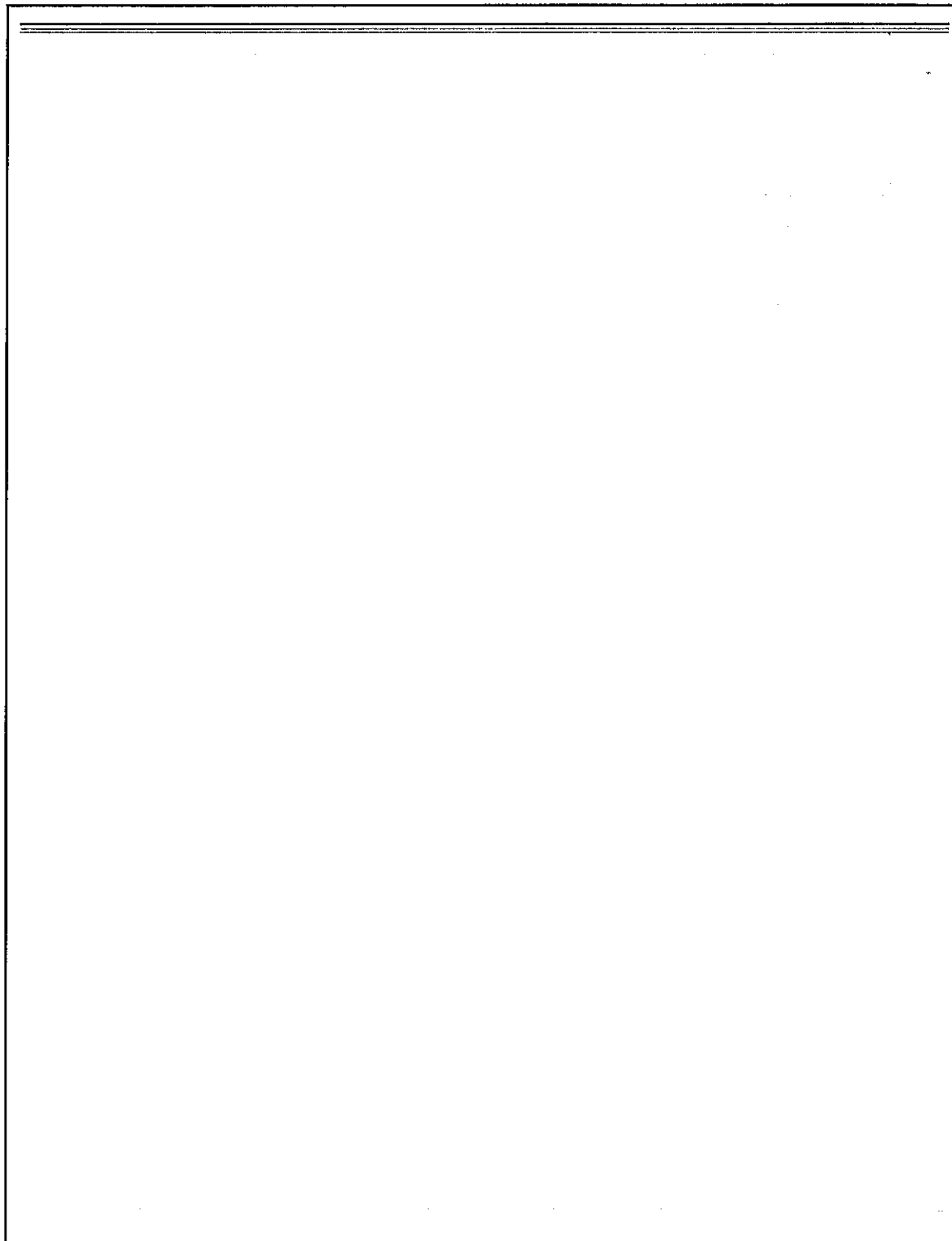
**Further Information:** Please contact Agilent for further information about this CRM.

**Quality Certifications:** This CRM was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 44 100 16560231)
- Accredited to ISO 17034 – General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.02)
  - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2848.01)

Document Name:

Certificate of Analysis Wavelength calibration solution



**Comments**

Date/Time:	September 13, 2021 5:27:56 PM
Test:	General
Comment:	Start OQ on 08 Sep 21 and found water flow fail, So repair job complete for 13 Sep 21 and OQ continue to complete.

## General

Document Name:

Instrument's Test Report

**Report Summary**

Instrument Model	Agilent 5100/5110 SVDV ICP-OES
Instrument ID	G8010A/G8014A
Instrument Serial Number	MY16010005
Software Version	7.5.3.11953
Firmware Version	5395
Tested By	Kanyakorn S.
Test started on	9/8/2021 9:51:21 AM
Test Completed On	9/8/2021 9:56:35 AM

**Result Summary**

Subsystem Communications Test	Pass
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

**Subsystem Communications Test****Pass****Optics Test****Pass**

	Radial	Axial	SVDV
Intensity	3082176	3162050	3419288
Wavelength	737.212	737.212	737.212

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Instrument's Test Report

Resolution Test		Pass
Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.54
As (188.980 nm)	≤ 8.20	6.43
C (193.027 nm)	≤ 11.50	8.89
Mo (202.032 nm)	≤ 8.20	6.50
Cr (206.158 nm)	≤ 13.40	11.05
Zn (213.857 nm)	≤ 8.70	7.27
Pb (220.353 nm)	≤ 9.50	7.52
Co (228.615 nm)	≤ 17.20	12.66
Ba (230.424 nm)	≤ 9.40	7.80
Mn (257.610 nm)	≤ 13.30	9.99
Mn (260.568 nm)	≤ 20.30	16.83
Cr (267.716 nm)	≤ 11.00	8.53
Cu (324.754 nm)	≤ 25.00	19.14
Cu (327.395 nm)	≤ 14.20	11.75
Sr (338.071 nm)	≤ 33.50	26.94
Ba (455.403 nm)	≤ 44.00	33.57
Sr (460.733 nm)	≤ 36.00	22.38
Ba (493.408 nm)	≤ 36.00	25.86
Ba (614.171 nm)	≤ 42.00	28.49
Ar (675.283 nm)	≤ 74.00	60.58
K (766.491 nm)	≤ 80.00	66.42

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Instrument's Test Report

**Sensitivity Test****Pass****Radial**

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	88.8	960.1	94.9
Se (196.026 nm)	≥ 41.0	SRBR	55.8	709.4	113.8
Zn (213.857 nm)	≥ 1421.0	SRBR	2095.3	29674.4	197.9
Pb (220.353 nm)	≥ 46.0	SRBR	100.6	1392.6	152.2
Mn (257.610 nm)	≥ 3518.0	SRBR	6641.7	127413.8	365.9
Al (396.152 nm)	≥ 3.4	SBR	6.9	24237.9	3081.8
Ba (493.408 nm)	≥ 34.0	SBR	95.1	1015416.2	10563.7
K (766.491 nm)	≥ 1.8	SBR	4.4	82043.9	15321.8

**Axial**

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	292.4	5108.5	273.5
Se (196.026 nm)	≥ 159.0	SRBR	199.9	3903.2	321.0
Zn (206.200 nm)	≥ 243.0	SRBR	793.6	12455.9	237.0
Zn (213.857 nm)	≥ 1743.0	SRBR	4924.5	130652.8	696.4
Cd (214.439 nm)	≥ 4227.0	SRBR	4508.6	87692.4	375.1
Pb (220.353 nm)	≥ 320.0	SRBR	327.3	7653.1	480.3
Mn (257.610 nm)	≥ 10625.0	SRBR	19008.6	632891.9	1104.7
Cr (267.716 nm)	≥ 1048.0	SRBR	4115.3	173999.6	1751.9
Cu (324.754 nm)	≥ 19.0	SBR	46.6	188303.3	3960.0
Al (396.152 nm)	≥ 6.0	SBR	16.7	156852.5	8877.5
Ba (493.408 nm)	≥ 60.0	SBR	168.0	5374075.7	31797.5
K (766.491 nm)	≥ 24.0	SBR	64.8	2536127.0	38564.9

**Precision Test****Pass****Radial**

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	1.08
Se (196.026 nm)	≤ 2.60	1.38
Zn (213.857 nm)	≤ 1.50	0.62
Pb (220.353 nm)	≤ 2.60	0.72
Mn (257.610 nm)	≤ 1.50	0.44

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Al (396.152 nm)	≤ 1.50	0.45
Ba (493.408 nm)	≤ 1.50	0.48
K (766.491 nm)	≤ 1.50	0.34

## Axial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.64
Se (196.026 nm)	≤ 1.50	0.58
Zn (206.200 nm)	≤ 1.50	0.29
Zn (213.857 nm)	≤ 1.50	0.38
Cd (214.439 nm)	≤ 1.50	0.30
Pb (220.353 nm)	≤ 1.50	0.47
Mn (257.610 nm)	≤ 1.50	0.78
Cr (267.716 nm)	≤ 1.50	0.30
Cu (324.754 nm)	≤ 1.50	0.45
Al (396.152 nm)	≤ 1.50	0.35
Ba (493.408 nm)	≤ 1.50	0.50
K (766.491 nm)	≤ 1.50	0.46

## Report Detail

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

## SubSystem Status

Mains Power Module - Passed  
 Gas Control Module - Passed  
 RF Generator - Passed  
 pre-optics Module - Passed  
 Optics/Camera Control Module - Passed  
 Peristaltic Pump - Passed  
 Subsystem Communications Test Completed - Passed

## Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed  
 Shutter opened - Passed  
 Peak Intensity Radial mode 3082176.14 - Passed  
 Shutter closed - Passed  
 Peak Intensity(closed shutter) Radial mode 55.00 - Passed  
 Shutter opened - Passed  
 Optical Argon Ratio: Calculated Value = 2.56, Factory Value = 2.60  
 Peak Intensity Axial mode 3162050.49 - Passed

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Instrument's Test Report

Radial-Axial Intensity Ratio:(Range 0-100) - 1.03 - Passed  
Peak Intensity Simultaneous mode 3419287.63 - Passed  
Shutter closed - Passed  
Optics Test Completed - Passed

Instrument Performance- Started

Instrument Performance Completed - Passed

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## General

Document Name:

Instrument's Test Report

**Report Summary**

Instrument Model	Agilent 5100/5110 SVDV ICP-OES
Instrument ID	G8010A/G8014A
Instrument Serial Number	MY16010005
Software Version	7.5.3.11953
Firmware Version	5395
Tested By	Kanyakorn S.
Test started on	9/13/2021 5:33:48 PM
Test Completed On	9/13/2021 5:46:50 PM

**Result Summary**

Subsystem Communications Test	Pass
Air Flow Test	Pass
Water Flow Test	Pass
Gas Flows Test	Pass
RF Generator Test	Pass
Camera Test	Pass
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Skipped
Sensitivity Test	Skipped
Precision Test	Skipped

**Subsystem Communications Test**

Pass

**Air Flow Test**

Pass

30% Air Flow (relative speed)	60% Air Flow (relative speed)
11.00	16.00

**Water Flow Test**

Pass

RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.21	1.14	23.01

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Document Name:

Instrument's Test Report

**Gas Flows Test****Pass**

Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.71	276.73	2.00	2.00	106.21
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	106.63	18.00	17.96	19.78

**RF Generator Test****Pass**

RF Power Supply Test	Passed
RF Power Supply (V)	130.332
RF Oscillator Test	Passed
RF Oscillator Frequency (MHz)	25.917
Work Coil Current (A)	44.873
RF Power Supply Current (A)	1.996

**Camera Test****Pass**

Black Level Test	Noise Test	Photo Response Test
Passed	Passed	Passed

**Optics Test****Pass**

	Radial	Axial	SVDV
Intensity	2965633	3009947	3265038
Wavelength	737.212	737.212	737.212

**Report Detail**

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

**SubSystem Status**

Mains Power Module - Passed  
Gas Control Module - Passed  
RF Generator - Passed  
pre-optics Module - Passed  
Optics/Camera Control Module - Passed

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Instrument's Test Report

Peristaltic Pump - Passed  
Subsystem Communications Test Completed - Passed

Air Flow- Started

Fan Speed(%) Air Flow(relative speed) Status

30% 11 - Passed  
60% 16 - Passed  
Air Flow Completed - Passed

Water Flow- Started

RF Water Flow(L/min) = 1.21  
Camera Water Flow (L/min) = 1.14  
Water Inlet Temperature = 23.01  
RF Water Flow(L/min) (off) = 0.00  
Water Flow Completed - Passed

Gas Flows- Started

Channel Target Actual Pressure Failure Status

Auxiliary Gas 0.00 0.06 N/A N/A - Passed  
Auxiliary Gas 2.00 2.00 N/A N/A - Passed  
Nebulizer Gas 0.00 0.07 0.00 N/A - Passed  
Nebulizer Gas 0.70 0.71 276.73 N/A - Passed  
Plasma Gas 0.00 1.18 N/A N/A - Passed  
Plasma Gas 18.00 17.96 N/A N/A - Passed  
Makeup Gas 0.00 0.08 N/A N/A - Passed  
Makeup Gas 2.00 2.00 N/A N/A - Passed  
Purge Gas 0.70 0.70 N/A N/A - Passed  
Purge Gas 3.70 3.70 N/A N/A - Passed  
All Channel flows ON : - Passed  
All Channel flows OFF : - Passed  
Gas Flows Completed - Passed

RF Generator- Started

RF generator turned off - Passed  
RF generator turned on - Passed  
Bias Control = 0 V - Passed  
RF Power Supply - Set Value = 150V, Actual Value = 130.33V - Passed  
RF Oscillator Started - Passed  
RF Oscillator Frequency(MHz) = 25.92 , Workcoil Current(Amps) = 44.87, RF Power Supply  
Current(Amps) = 2.00 - Passed  
RF Oscillator stopped - Passed  
RF generator turned off - Passed  
RF Generator Completed - Passed

Camera Test- Started

Black level test - PASSED  
Noise test - PASSED  
Photo response test - PASSED  
Camera Test Completed - Passed

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed

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Document Name:

Instrument's Test Report

Plasma ignite Started  
Plasma ignite - Passed  
Waiting 5 min for plasma warm up  
Shutter opened - Passed  
Peak Intensity Radial mode 2965632.60 - Passed  
Shutter closed - Passed  
Peak Intensity(closed shutter) Radial mode 55.46 - Passed  
Shutter opened - Passed  
Optical Argon Ratio: Calculated Value = 2.53, Factory Value = 2.60  
Peak Intensity Axial mode 3009947.39 - Passed  
Radial-Axial Intensity Ratio:(Range 0-100) - 1.01 - Passed  
Peak Intensity Simultaneous mode 3265038.45 - Passed  
Shutter closed - Passed  
Optics Test Completed - Passed

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Date:  
System ID:

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MY16010005

## Electronic Signature

### Purpose

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### Details

Full Name of Signer:	Kanyakorn Sukpathrajareem
Logged On User Name:	phimprapha.jeeraphong@agilent.com
Signature Creation Date:	September 13, 2021
Reason for Signature:	Executed protocol and published this original version of document

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User Name: phlmpapha.jeeraphong  
 Hostname: ASBKKWX328

System Id: MY16010005  
 Print Date: September 13, 2021 5:50:44 PM

QQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 8:49:59 AM	Audit	SessionCreated	Session	None
September 8, 2021 8:49:59 AM	Start	Configuration	Session	None
September 8, 2021 8:49:59 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
September 8, 2021 9:07:06 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended]
September 8, 2021 9:07:11 AM	End	Configuration	Session	None
September 8, 2021 9:07:15 AM	Start	Qualification	Session	OQ
September 8, 2021 9:07:15 AM	Start	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:34:35 AM	End	Execution	Preparation : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:34:39 AM	Start	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:27 AM	End	Execution	Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated	Run Count : 1

User Name: phimprapha.jeeraphong  
Hostname: ASBKWX328

System Id: MY16010005  
Print Date: September 13, 2021 5:50:44 PM

## OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 9:51:30 AM	Start	Execution	Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated	None
September 8, 2021 9:51:36 AM	End	Execution	Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated	Run Count : 1
September 8, 2021 9:51:38 AM	End	Qualification	Session	OQ
September 8, 2021 9:51:38 AM	Start	Reporting	Session	None
September 8, 2021 10:55:40 AM	Audit	AceClosed	Session	None
September 13, 2021 5:01:26 PM	Audit	AceRestarted	Session	None
September 13, 2021 5:01:26 PM	Audit	SessionReloaded	Session	None
September 13, 2021 5:01:28 PM	Start	Qualification	Session	OQ
September 13, 2021 5:47:55 PM	Audit	Reporting	Session	Report Generated : Certificate

User Name: phimprapha.jeeraphong  
Hostname: ASBKWX328

System Id: MY16010005  
Print Date: September 13, 2021 5:50:44 PM

## OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 13, 2021 5:49:13 PM	Audit	Reporting	Session	Report Signed : Certificate PDF Name: OQHW 5100 ICPOES ALS 08Sep21_20210913_Certificate_1.pdf User Name: phimprapha.jeeraphong@agilent.com Full Name of Signer: Kanyakorn Sukpathrajareon Reason for signature: Executed protocol and published this original version of document
September 13, 2021 5:49:25 PM	Audit	Reporting	Session	Report Generated : Report

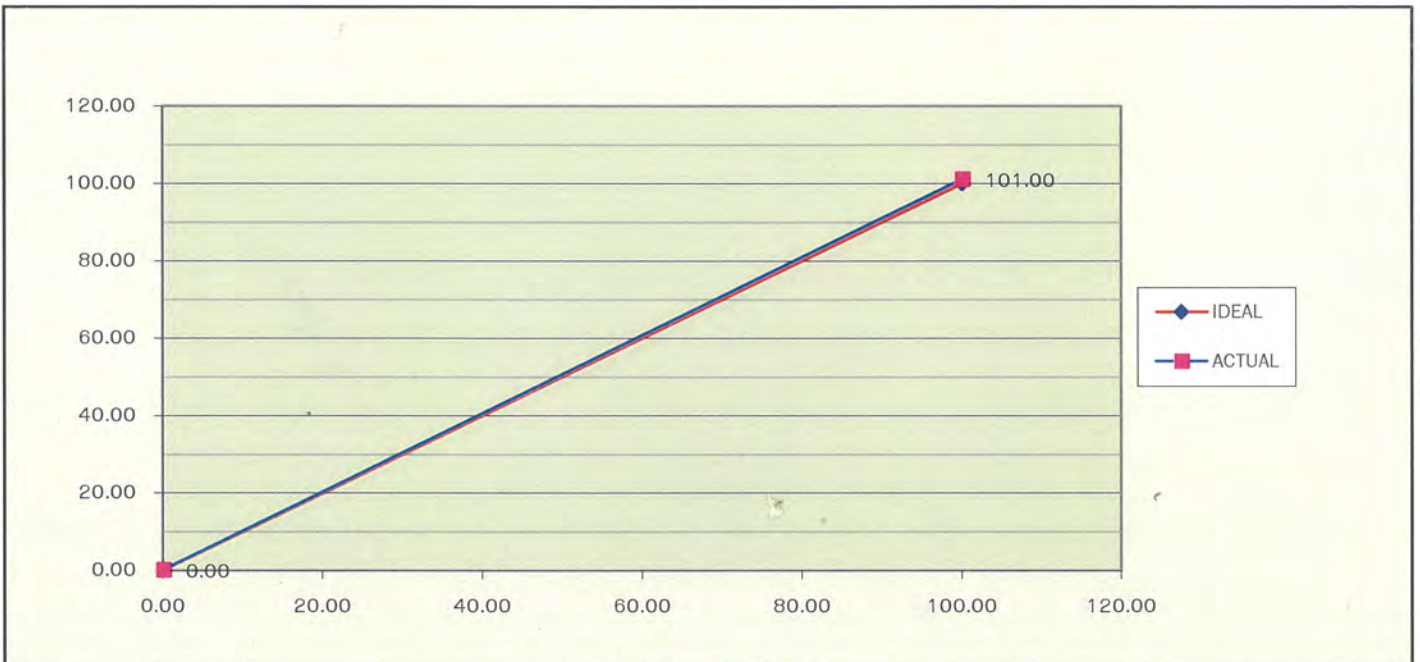
**CALIBRATION REPORT**

REVIEW BY Vichuta N.  
APPROVED BY Sararat M.  
NEXT CAL. DATE 9/2/67

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd.	
EQUIPMENT NAME : Total Hydrocarbon Analyzer	
MANUFACTURER : Baseline	MODEL : 9000 NMHC SERIAL NO : 0314DR0170
STANDARD GAS CONCENTRATION (PPM) : 100 PPM (Methane)	
CYLINDER PRESSURE (psig) : 900 PSI	CERTIFIED DATE : 12/02/2022
CERTIFIED BY : AIRGAS	EXPIRED DATE : 12/02/2025

**CALIBRATION RESULTS**

POINT NO	CALIBRATION RESULTS			
	IDEAL	ACTUAL	ERROR	%ERROR
ZERO	0.00	0.00	0.00	-
1	100.00	101.00	1.0	-1.00
AVERAGE (%)				0.25



CALIBRATED BY : วิภาพล ดุสิตเจริญ

DATE : 9/8/65

CHECKED BY : ศุภชัย อังคาร

DATE : 9/8/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 31 , E-Mail : Engineer@Jiranatee.com

เลขที่ 63/14-15,67/35-36 ถนน เพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

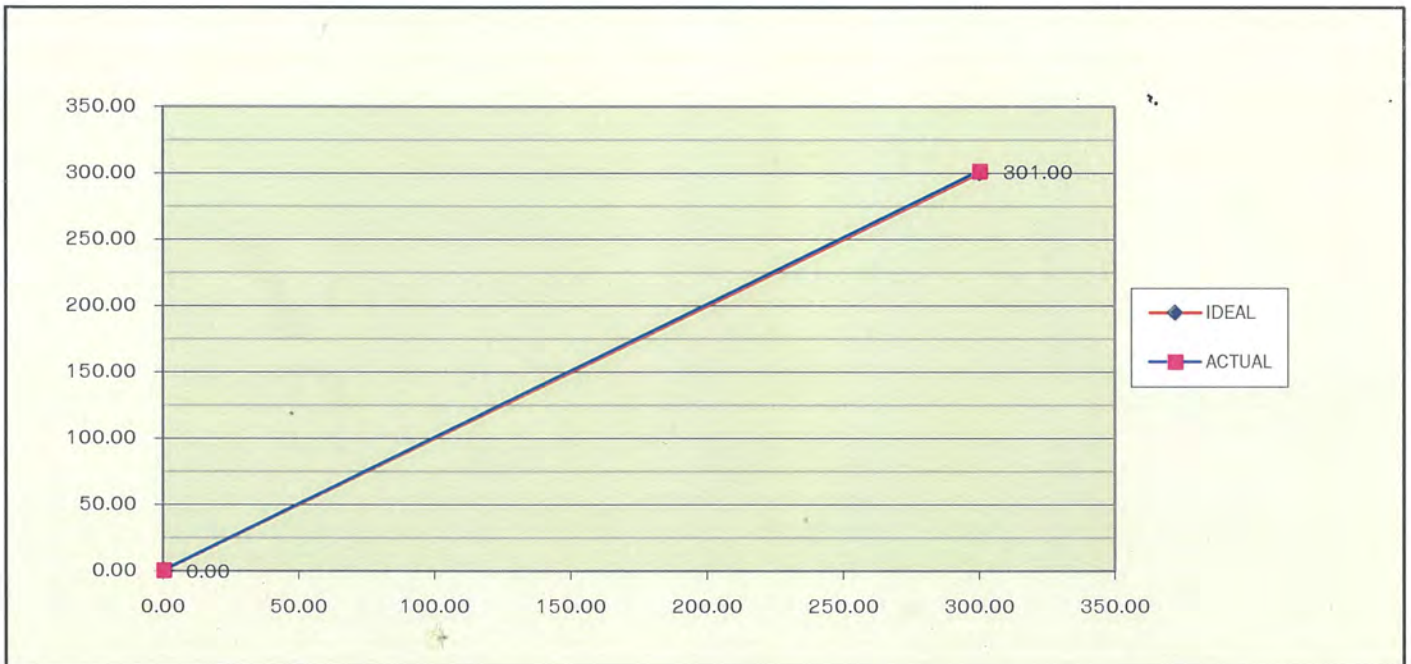


## CALIBRATION REPORT

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd.	
EQUIPMENT NAME : Total Hydrocarbon Analyzer	
MANUFACTURER : Baseline	MODEL : 9000 NMHC SERIAL NO : 0314DR0170
STANDARD GAS CONCENTRATION (PPM) : 100 PPM ( Propane )	
CYLINDER NO : ND55981	
CYLINDER PRESSURE (psig) : 900 PSI	CERTIFIED DATE : 12/02/2022
CERTIFIED BY : AIRGAS	EXPIRED DATE : 12/02/2025

### CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL	ACTUAL	ERROR	%ERROR
ZERO	0.00	0.00	0.00	-
1	300.00	301.00	1.0	0.33
AVERAGE (%)				0.08



CALIBRATED BY : วรณล ศักดิ์เจริญ DATE : 9/18/65

CHECKED BY : ศิษฐ์ วัฒนา DATE : 9/18/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 31 , E-Mail : Engineer@jiranatee.com

เลขที่ 63/14-15,67/35-36 ถนนเพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

**FLOW CALIBRATE**

<b>CUSTOMER NAME</b>	: ALS Laboratory Group (Thailand) Co., Ltd.		
<b>EQUIPMENT NAME</b>	: Flow Calibrator		
<b>MANUFACTURER</b>	: Bios	<b>MODEL</b>	: 510 L
		<b>SERIAL NO</b>	: 129549

Flow Parameter	Step	Set	Display	Flow Meter
Sample	Before	40	38	15 cc/min
	After	40	40	39.7 cc/min
Air	Before	175	175	190 cc/min
	After	175	175	176 cc/min
Fuel	Before	35	32	36 cc/min
	After	35	35	35 cc/min

**CALIBRATED BY :** วราพล ดวกิ่งเจริญ **DATE :** 9/8/65  
**CHECKED BY :** สันติ วัฒนะ **DATE :** 9/8/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com  
 เลขที่ 63/14-15,67/35-36 ถนน เพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

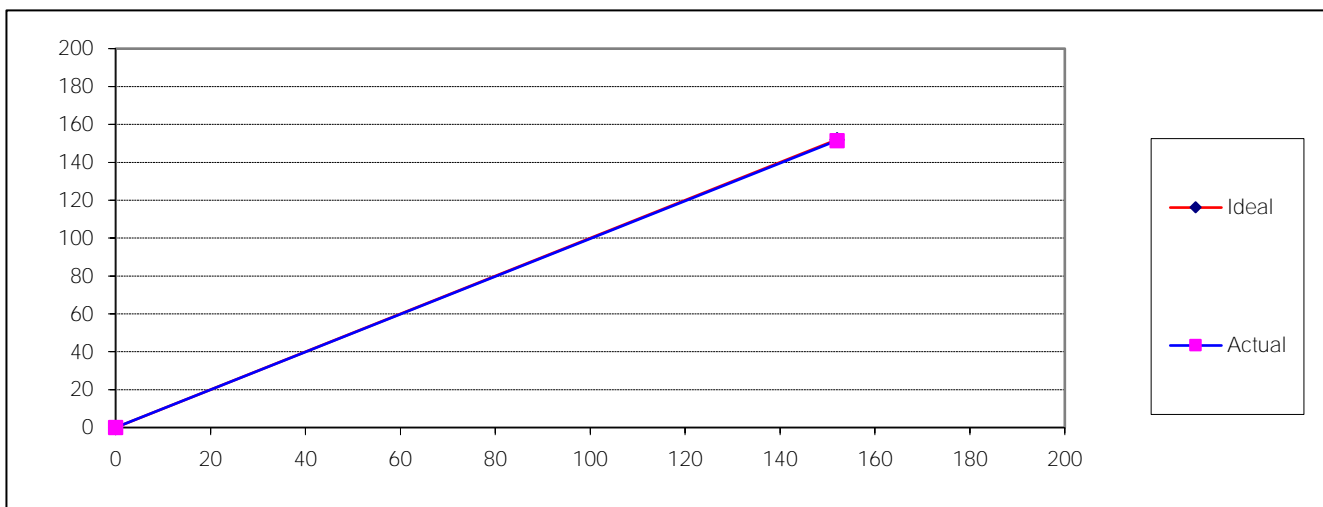


## CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment ID	BKK_FS0758
Equipment Name	FID Analyzer	Manufacturer	Baseline Mocon
Model	9000H	Serial No.	0315EF0047
Std.Gas Conc.(ppm)	152	Cylinder No.	D878173
Certified Date	27-Jun-18	Expired Date	27-Jun-26

### CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
SPAN	152.00	151.50	-0.50	-0.33
AVERAGE (%)				-0.14



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager



## ROTA METER CALIBRATION RESULT JANUARY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	03 Jan 23	$Y = 1.0259x - 0.6354$	0.9997
BKK_FS0579	05 Jan 23	$Y = 1.0005x + 0.2803$	1.0000
BKK_FS0583	05 Jan 23	$Y = 0.9976x + 1.2146$	1.0000
BKK_FS0584	03 Jan 23	$Y = 1.0104x - 0.3929$	1.0000
BKK_FS0586	05 Jan 23	$Y = 1.001x - 1.3619$	0.9999
BKK_FS0587	03 Jan 23	$Y = 1.0038x + 0.881$	1.0000
BKK_FS0588	05 Jan 23	$Y = 1.0015x - 0.6876$	0.9999
BKK_FS0590	05 Jan 23	$Y = 0.9958x + 1.7452$	1.0000
BKK_FS0591	03 Jan 23	$Y = 0.9677x + 64.54$	0.9951
BKK_FS0593	03 Jan 23	$Y = 0.9792x + 21.393$	0.9972
BKK_FS0594	03 Jan 23	$Y = 1.0455x - 43.344$	0.9976
BKK_FS0595	05 Jan 23	$Y = 0.9993x + 1.18$	1.0000
BKK_FS0597	05 Jan 23	$Y = 0.9788x + 22.286$	0.9971
BKK_FS1004	03 Jan 23	$Y = 0.9943x + 7.1619$	0.9996
BKK_FS1005	03 Jan 23	$Y = 1.0045x + 2.1167$	0.9998
BKK_FS1006	03 Jan 23	$Y = 1.0288x - 0.3852$	0.9999
BKK_FS1008	03 Jan 23	$Y = 1.0181x + 0.1282$	0.9998
BKK_FS1009	05 Jan 23	$Y = 1.0018x + 1.1293$	1.0000
BKK_FS1011	03 Jan 23	$Y = 1.0463x - 1.9344$	0.9985
BKK_FS1012	03 Jan 23	$Y = 1.0082x - 53.425$	0.9999
BKK_FS1013	03 Jan 23	$Y = 1.0058x - 9.701$	1.0000
BKK_FS1014	05 Jan 23	$Y = 0.9869x + 1.2643$	0.9995
BKK_FS1015	05 Jan 23	$Y = 1.004x - 0.7571$	0.9999
BKK_FS1016	05 Jan 23	$Y = 0.978x + 24.623$	0.9973
BKK_FS1017	17 Jan 23	$Y = 1.0022x + 0.4211$	1.0000
BKK_FS1018	17 Jan 23	$Y = 0.9893x + 5.8317$	1.0000
BKK_FS1019	17 Jan 23	$Y = 0.9859x - 11.574$	0.9986
BKK_FS1020	03 Jan 23	$Y = 1.0208x - 0.6221$	0.9998
BKK_FS1021	03 Jan 23	$Y = 0.992x - 44.599$	0.9997
BKK_FS1022	03 Jan 23	$Y = 1.0067x - 12.483$	0.9999
BKK_FS1023	03 Jan 23	$Y = 1.0013x + 0.5823$	0.9993
BKK_FS1024	03 Jan 23	$Y = 1.0036x - 50.787$	0.9999
BKK_FS1025	03 Jan 23	$Y = 0.974x + 27.034$	0.9969
BKK_FS1026	05 Jan 23	$Y = 0.9783x + 1.7075$	0.9991
BKK_FS1027	05 Jan 23	$Y = 1.145x - 90.325$	0.9797
BKK_FS1028	05 Jan 23	$Y = 0.9815x + 13.626$	0.9969
BKK_FS1029	03 Jan 23	$Y = 0.9706x + 3.6283$	0.9951
BKK_FS1030	03 Jan 23	$Y = 1.0197x - 52.982$	0.9999
BKK_FS1031	03 Jan 23	$Y = 0.9995x - 0.1581$	1.0000



## ROTA METER CALIBRATION RESULT JANUARY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1039	03 Jan 23	$Y = 1.0242x - 4.3007$	0.9986
BKK_FS1040	03 Jan 23	$Y = 1.0035x + 1.0705$	0.9998
BKK_FS1041	03 Jan 23	$Y = 0.9791x + 0.252$	1.0000
BKK_FS1042	03 Jan 23	$Y = 1.0186x - 3.7429$	0.9999
BKK_FS1043	03 Jan 23	$Y = 1.0038x + 2.961$	0.9999
BKK_FS1044	03 Jan 23	$Y = 1.0189x + 0.2969$	1.0000
BKK_FS1163	18 Jan 23	$Y = 1.0127x + 0.8332$	0.9996
BKK_FS1164	18 Jan 23	$Y = 1.2176x + 4.7376$	0.9952
BKK_FS1165	18 Jan 23	$Y = 1.0005x - 47.94$	1.0000
BKK_FS1166	18 Jan 23	$Y = 1.0346x - 35.841$	0.9996
BKK_FS1200	03 Jan 23	$Y = 1.0168x + 0.4034$	0.9997
BKK_FS1201	03 Jan 23	$Y = 0.7655x + 60.985$	0.9986
BKK_FS1202	03 Jan 23	$Y = 0.9593x + 87.615$	0.9958
RYG_FS0197	03 Jan 23	$Y = 1.0305x - 94.849$	0.9991
RYG_FS0198	03 Jan 23	$Y = 1.0103x - 19.254$	0.9999
RYG_FS0199	03 Jan 23	$Y = 0.9897x + 0.998$	0.9983

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittrantont)

Assistant General Manager





## ROTA METER CALIBRATION RESULT APRIL 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	03 Apr 23	$Y = 1.0246x - 1.1844$	0.9982
BKK_FS0579	03 Apr 23	$Y = 1.0313x - 0.8177$	0.9999
BKK_FS0583	03 Apr 23	$Y = 1.0023x - 0.0969$	0.9995
BKK_FS0584	03 Apr 23	$Y = 1.0025x + 2.25$	0.9999
BKK_FS0585	03 Apr 23	$Y = 0.9881x + 5.4452$	0.9993
BKK_FS0586	03 Apr 23	$Y = 0.9915x + 4.7452$	1.0000
BKK_FS0588	03 Apr 23	$Y = 1.0067x + 0.6738$	0.9998
BKK_FS0589	03 Apr 23	$Y = 0.9823x + 0.3286$	0.9936
BKK_FS0590	03 Apr 23	$Y = 0.9961x + 2.8786$	0.9999
BKK_FS0591	03 Apr 23	$Y = 0.9985x + 4.579$	1.0000
BKK_FS0592	03 Apr 23	$Y = 0.9975x + 3.6419$	1.0000
BKK_FS0593	03 Apr 23	$Y = 0.9966x + 16.005$	1.0000
BKK_FS0595	03 Apr 23	$Y = 0.9957x + 5.1368$	0.9999
BKK_FS0596	03 Apr 23	$Y = 1.017x - 14.044$	0.9967
BKK_FS0597	03 Apr 23	$Y = 1.0063x - 10.787$	1.0000
BKK_FS1004	01 Apr 23	$Y = 0.9943x + 7.1533$	0.9996
BKK_FS1005	01 Apr 23	$Y = 1.0035x + 3.1167$	0.9998
BKK_FS1006	01 Apr 23	$Y = 1.0273x - 0.4922$	0.9998
BKK_FS1007	03 Apr 23	$Y = 1.0452x - 1.5374$	0.9998
BKK_FS1009	03 Apr 23	$Y = 1.0351x - 1.3224$	0.9999
BKK_FS1010	03 Apr 23	$Y = 1.0108x - 0.0888$	1.0000
BKK_FS1011	03 Apr 23	$Y = 1.2946x - 6.6325$	0.9861
BKK_FS1012	03 Apr 23	$Y = 1.0976x - 27.969$	0.9996
BKK_FS1013	03 Apr 23	$Y = 1.0821x - 200.52$	0.9998
BKK_FS1017	03 Apr 23	$Y = 1.0333x + 7.0584$	0.9694
BKK_FS1018	03 Apr 23	$Y = 0.9551x - 18.832$	0.9997
BKK_FS1019	03 Apr 23	$Y = 1.0649x - 156.67$	0.9976
BKK_FS1020	03 Apr 23	$Y = 0.9911x + 0.0364$	0.9994
BKK_FS1021	03 Apr 23	$Y = 0.979x + 8.2333$	0.9992
BKK_FS1022	03 Apr 23	$Y = 0.9988x - 2.4905$	0.9997
BKK_FS1023	03 Apr 23	$Y = 1.0245x - 1.3878$	0.9996
BKK_FS1024	03 Apr 23	$Y = 0.7414x + 47.3$	0.9923
BKK_FS1025	03 Apr 23	$Y = 0.9997x + 5.4438$	1.0000
BKK_FS1026	03 Apr 23	$Y = 1.0172x - 0.9531$	1.0000
BKK_FS1027	03 Apr 23	$Y = 0.7331x + 49.317$	0.9921
BKK_FS1028	03 Apr 23	$Y = 0.9995x + 0.2124$	1.0000
BKK_FS1039	01 Apr 23	$Y = 1.025x - 3.795$	0.9994
BKK_FS1040	01 Apr 23	$Y = 1.0035x - 2.4295$	0.9998





## ROTA METER CALIBRATION RESULT APRIL 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1041	01 Apr 23	$Y = 1.0329x - 0.6769$	0.9999
BKK_FS1042	01 Apr 23	$Y = 1.0144x + 1.94$	0.9997
BKK_FS1043	01 Apr 23	$Y = 1.0038x - 1.539$	0.9999
BKK_FS1044	01 Apr 23	$Y = 1.0273x - 1.6922$	0.9998
BKK_FS1164	03 Apr 23	$Y = 0.9913x + 0.8537$	0.9997
BKK_FS1165	03 Apr 23	$Y = 1.0005x + 2.0857$	1.0000
BKK_FS1166	03 Apr 23	$Y = 1.0842x - 169.6$	0.9987
BKK_FS1200	03 Apr 23	$Y = 0.9452x + 5.2959$	0.9981
BKK_FS1201	03 Apr 23	$Y = 1.0045x - 1.8786$	1.0000
BKK_FS1202	03 Apr 23	$Y = 0.9768x + 26.572$	0.9973
RYG_FS0197	01 Apr 23	$Y = 1.0042x + 15.442$	0.9999
RYG_FS0198	01 Apr 23	$Y = 1.0081x - 13.26$	0.9999
RYG_FS0199	01 Apr 23	$Y = 1.0255x - 1.2364$	0.9999

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittrantont)

Assistant General Manager

**Sartorius (Thailand) Co., Ltd.**

129 Rama 9 Road, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6, e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate

## of Calibration

REVIEW BY	<u>Siriruk P.</u>
APPROVED BY	<u>KL AL</u>
NEXT CAL. DATE	<u>8/2/24</u>

Model Number : XP105DU  
Description : Semi-micro Balance  
Serial Number : 1123091884  
ID No. : BKK\_EN0004  
Manufacturer : Mettler Toledo

Certificate No. : 23BC10071  
Issued Date : Monday, February 13, 2023  
Reference No. : 203245  
Page No. : 1 of 3

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

Calibrated Place : Balance Room.

Calibrated By : Mr. Chonchai Inthana  
Calibration Date : Wednesday, February 08, 2023

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

**Metrological data :**

Capacity : 31/120 g Readability : 0.0001 g

**Ambients Conditions:**

Temperature : 21.0 °C ± 3.0 °C

Humidity : 65.0 % RH ± 5.0 % RH

Pressure : - ± -

**Reasons for calibration**

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

Equipment Condition: ☒ Good Operate ☐ Fair

### Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expended uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form list of Sartorius Metrological Specifications.

### Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 1kg E2 s/n 37929119	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.

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

Mr.Chonchai Inthana(Technical Manager)

S  
T  
A  
M  
P



# Certificate of Calibration

Model Number : XP105DU

Description : Semi-micro Balance

Serial Number : 1123091884

ID No. BKK\_EN0004

Manufacturer : Mettler Toledo

Certificate No. : 23BCI0071

Issued Date : Monday, February 13, 2023

Reference No. : 203245

Page No. : 2 of 3

## Calibration Results : Without Adjustment

### Repeatability

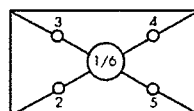
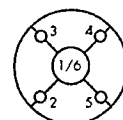
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)	2.00002	20.00002
2 g	2.00001	20.00001
Tolerance	2.00002	20.00001
N/A g	2.00002	20.00001
Nominal Value : (High Load)	2.00002	20.00000
20 g	2.00002	20.00001
Tolerance	2.00002	20.00000
N/A g	2.00001	20.00000
	2.00001	20.00001
Standard Deviation	0.000005	0.000007

### Eccentricity (Off-center loading error)

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

Nominal value : 20 g  
Tolerance N/A g



	Difference
1	—
2	-0.00002
3	-0.00004
4	0.00002
5	0.00003
6	—

### Linearity

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

Tolerance N/A g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.1	0.10000	0.10000	0.00000	0.000022
0.5	0.50001	0.50000	-0.00001	0.000023
1	1.00000	1.00000	0.00000	0.000024
2	2.00002	2.00001	-0.00001	0.000026
5	5.00002	5.00002	0.00000	0.000030
10	10.00002	10.00002	0.00000	0.000035
15	15.00004	15.00004	0.00000	0.000053
20	20.00000	20.00000	0.00000	0.000053
25	25.00002	25.00002	0.00000	0.000089
30	30.00002	30.00004	0.00002	0.000089

# Certificate of Calibration

Model Number : XS105DU  
 Description : Semi-micro Balance  
 Serial Number : 1123091884  
 ID No. : BKK\_EN0004  
 Manufacturer : Mettler Toledo

Certificate No. : 23BCI0071  
 Issued Date : Monday, February 13, 2023  
 Reference No. : 203245  
 Page No. : 3 of 3

## Calibration Results : Without Adjustment

### Repeatability

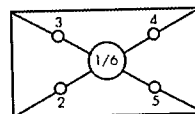
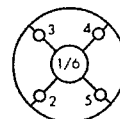
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)		100.0000
g		100.0000
Tolerance		100.0000
N/A g		100.0000
		100.0000
Nominal Value : (High Load)		100.0000
100 g		100.0000
Tolerance		99.9999
N/A g		100.0000
		100.0000
Standard Deviation		0.00003

### Eccentricity (Off-center loading error)

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

Nominal value : g  
 Tolerance N/A g



#### Difference

1	—
2	—
3	—
4	—
5	—
6	—

### Linearity

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

Tolerance N/A g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
50	50.0000	50.0000	0.0000	0.00012
55	55.0000	55.0000	0.0000	0.00015
60	60.0000	60.0000	0.0000	0.00015
65	65.0001	65.0001	0.0000	0.00015
70	70.0000	70.0000	0.0000	0.00015
80	80.0000	80.0000	0.0000	0.00017
90	90.0001	90.0001	0.0000	0.00018
100	100.0000	100.0000	0.0000	0.00018
110	110.0000	110.0000	0.0000	0.00026
120	120.0000	120.0000	0.0000	0.00026

End of Report.

# SITHIPHORN ASSOCIATES CO.,LTD.

## CALIBRATION LABORATORY



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

Cert. No. : ACC22012

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-74  
**Serial No.:** 34178117  
**ID No.:** BKK\_FS0630

**Condition As Found :** GOOD

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

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

**Received Date :** 22 APRIL 2022  
**Calibration Date :** 26 APRIL 2022  
**Date of Issue :** 29 APRIL 2022

REVIEW BY	<i>Marakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	26/4/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchurai*  
( Thanakul Petchurai )

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



## Continuation of Calibration Certificate

Cert. No. : ACC22012

Job No. : VC65AC0055

Pages : 2 of 3

Calibration Procedure : CP-AC-03

**Calibration Method :**

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33511B	MY52302742	EF-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).



## Continuation of Calibration Certificate

Cert. No. : ACC22012

Job No. : VC65AC0055

Pages : 3 of 3

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

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.13	0.13	0.14	0.40

**2. Frequency**

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1000	1001.7	0.2	0.1	1.0

**3. Total distortion**

Measured value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1.73	0.10	3.0

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

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

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22177

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00658241 / 158767 / 58769  
**ID No.:** BKK\_FS0098

**Condition As Found :** GOOD

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

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

**Received Date :** 25 JULY 2022  
**Calibration Date :** 15-18 AUGUST 2022  
**Date of Issue :** 19 AUGUST 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	15/8/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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



## Continuation of Calibration Certificate

Cert. No. : ACL22177

Job No. : VC65AC0071

Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-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).

Continuation of Calibration Certificate

Cert. No. : ACL22177  
Job No. : VC65AC0071  
Pages : 3 of 8

**Summary of Measurement Result :**

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



## Continuation of Calibration Certificate

Cert. No. : ACL22177

Job No. : VC65AC0071

Pages : 4 of 8

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

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

**2. Self-generated noise**

## 2.1 Normal test

Measured Value ( dB )
16.1

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	18.0
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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.5	0.5	0.6	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.7	-1.7	-1.7	±5.0

## Continuation of Calibration Certificate

Cert. No. : ACL22177

Job No. : VC65AC0071

Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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



Continuation of Calibration Certificate

Cert. No. : ACL22177  
Job No. : VC65AC0071  
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**7. Level linearity on the reference level range**

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	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	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

## Continuation of Calibration Certificate

Cert. No. : ACL22177  
 Job No. : VC65AC0071  
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**8. Level linearity including the level range control**

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

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lcpeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	132.9	-0.1	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0



**Continuation of Calibration Certificate**

**Cert. No. : ACL22177**  
**Job No. : VC65AC0071**  
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**11. Overload indication**

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

**12. High level stability**

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

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

**End of Calibration Certificate**

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbunru, Bangplud Bangkok 10700 THAILAND.  
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NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : ACL22167

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00658242 / 157782 / 48097  
**ID No.:** BKK\_FS0099

**Condition As Found :** GOOD

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

**Location :** -

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

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

REVIEW BY	<i>Narakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	11/11/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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



## Continuation of Calibration Certificate

Cert. No. : ACL22167

Job No. : VC65AC0069

Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
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).



Continuation of Calibration Certificate

Cert. No. : ACL22167  
Job No. : VC65AC0069  
Pages : 3 of 8

**Summary of Measurement Result :**

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

## Continuation of Calibration Certificate

Cert. No. : ACL22167

Job No. : VC65AC0069

Pages : 4 of 8

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

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

**2. Self-generated noise**

## 2.1 Normal test

Measured Value ( dB )
17.7

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

Frequency Weighting	Measured value ( dB )
A - weight	16.1
C - weight	21.7
Flat	27.4

**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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.2	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.4	-1.3	-1.3	±5.0



Continuation of Calibration Certificate

Cert. No. : ACL22167  
Job No. : VC65AC0069  
Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	-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	0.1	0.1	±5.0

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

**6. Long - term stability**

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

## Continuation of Calibration Certificate

Cert. No. : ACL22167

Job No. : VC65AC0069

Pages : 6 of 8

## 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	$\pm 1.1$
136.0	136.0	0.0	$\pm 1.1$
135.0	135.0	0.0	$\pm 1.1$
134.0	134.0	0.0	$\pm 1.1$
133.0	133.0	0.0	$\pm 1.1$
132.0	132.0	0.0	$\pm 1.1$
131.0	131.0	0.0	$\pm 1.1$
129.0	129.0	0.0	$\pm 1.1$
124.0	124.0	0.0	$\pm 1.1$
119.0	119.0	0.0	$\pm 1.1$
114.0	114.0	0.0	$\pm 1.1$
109.0	109.0	0.0	$\pm 1.1$
104.0	104.0	0.0	$\pm 1.1$
99.0	99.0	0.0	$\pm 1.1$
94.0	94.0	0.0	$\pm 1.1$
89.0	89.0	0.0	$\pm 1.1$
84.0	84.0	0.0	$\pm 1.1$
79.0	79.0	0.0	$\pm 1.1$
74.0	74.0	0.0	$\pm 1.1$
69.0	69.0	0.0	$\pm 1.1$
64.0	64.0	0.0	$\pm 1.1$
59.0	59.0	0.0	$\pm 1.1$
54.0	54.0	0.0	$\pm 1.1$
49.0	49.0	0.0	$\pm 1.1$
44.0	44.0	0.0	$\pm 1.1$
39.0	39.0	0.0	$\pm 1.1$
34.0	34.0	0.0	$\pm 1.1$
30.0	30.0	0.0	$\pm 1.1$
29.0	29.0	0.0	$\pm 1.1$
28.0	27.9	-0.1	$\pm 1.1$
27.0	27.1	0.1	$\pm 1.1$
26.0	26.0	0.0	$\pm 1.1$
25.0	25.1	0.1	$\pm 1.1$



Continuation of Calibration Certificate

Cert. No. : ACL22167

Job No. : VC65AC0069

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**8. Level linearity including the level range control**

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

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	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	135.6	-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



## Continuation of Calibration Certificate

Cert. No. : ACL22167

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## 11. Overload indication

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

End of Calibration Certificate

# SITHIPHORN 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. : ACL22168

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00658243 / 157783 / 48098  
**ID No.:** BKK\_FS0100

**Condition As Found :** GOOD

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

**Location :** -

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

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

REVIEW BY	Narakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	11/7/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

[Signature]  
( Thanakul Petchurai )

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



## Continuation of Calibration Certificate

Cert. No. : ACL22168

Job No. : VC65AC0069

Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
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).

Continuation of Calibration Certificate

Cert. No. : ACL22168  
Job No. : VC65AC0069  
Pages : 3 of 8

**Summary of Measurement Result :**

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



## Continuation of Calibration Certificate

Cert. No. : ACL22168

Job No. : VC65AC0069

Pages : 4 of 8

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

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

**2. Self-generated noise**

## 2.1 Normal test

Measured Value ( dB )
15.7

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

Frequency Weighting	Measured value ( dB )
A - weight	13.1
C - weight	19.1
Flat	25.0

**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	0.3	± 1.5
1000	0.0	-0.1	0.0	± 1.0
8000	-1.4	-1.4	-1.4	±5.0



Continuation of Calibration Certificate

Cert. No. : ACL22168

Job No. : VC65AC0069

Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-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	0.0	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

## Continuation of Calibration Certificate

Cert. No. : ACL22168

Job No. : VC65AC0069

Pages : 6 of 8

## 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	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	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	0.2	± 1.1



Continuation of Calibration Certificate

**Cert. No. : ACL22168**

**Job No. : VC65AC0069**

**Pages : 7 of 8**

**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	135.6	-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

Continuation of Calibration Certificate

Cert. No. : ACL22168

Job No. : VC65AC0069

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** —————



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : ACL22302

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00858521 / 158765 / 58767  
**ID No.:** BKK\_FS0111

**Condition As Found :** GOOD

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

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

**Received Date :** 07 DECEMBER 2022  
**Calibration Date :** 16-20 DECEMBER 2022  
**Date of Issue :** 21 DECEMBER 2022

REVIEW BY	<i>Nithakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	16/12/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL22302

Job No. : VC66AC0016

Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-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).

Continuation of Calibration Certificate

Cert. No. : ACL22302

Job No. : VC66AC0016

Pages : 3 of 8

**Summary of Measurement Result :**

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



## Continuation of Calibration Certificate

Cert. No. : ACL22302

Job No. : VC66AC0016

Pages : 4 of 8

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

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

**2. Self-generated noise**

## 2.1 Normal test

Measured Value ( dB )
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	18.1
Flat	23.8

**3. Acoustical signal tests of frequency weightings**

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.3	0.3	0.4	± 1.5
1000	0.1	0.0	0.0	± 1.0
8000	-1.9	-1.8	-1.8	±5.0

Continuation of Calibration Certificate

**Cert. No. : ACL22302**  
**Job No. : VC66AC0016**  
**Pages : 5 of 8**

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	-0.1	±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	-0.1	±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



Continuation of Calibration Certificate

**Cert. No. : ACL22302**  
**Job No. : VC66AC0016**  
**Pages : 6 of 8**

**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	59.1	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	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1



Continuation of Calibration Certificate

Cert. No. : ACL22302

Job No. : VC66AC0016

Pages : 7 of 8

**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	135.4	-1.0	±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

Continuation of Calibration Certificate

Cert. No. : ACL22302

Job No. : VC66AC0016

Pages : 8 of 8

**11. Overload indication**

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.7	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 level 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. : ACC22043

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-74  
**Serial No.:** 34178118  
**ID No.:** BKK\_FS0631

**Condition As Found :** GOOD

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

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

**Received Date :** 07 DECEMBER 2022  
**Calibration Date :** 20 DECEMBER 2022  
**Date of Issue :** 21 DECEMBER 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	20/12/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACC22043

Job No. : VC66AC0016

Pages : 2 of 3

Calibration Procedure : CP-AC-03

**Calibration Method :**

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33511B	MY52302742	EF-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).



## Continuation of Calibration Certificate

Cert. No. : ACC22043

Job No. : VC66AC0016

Pages : 3 of 3

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

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.13	0.13	0.14	0.40

**2. Frequency**

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1000	1001.7	0.2	0.1	1.0

**3. Total distortion**

Measured value ( % )	Uncertainty ( % )	Tolerance limit ( % )
2.13	0.10	3.0

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

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

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL22246

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597155 / 180398 / 88168  
**ID No.:** BKK\_FS0993

**Condition As Found :** GOOD

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

**Location :** -

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

**Received Date :** 11 OCTOBER 2022  
**Calibration Date :** 25-26 OCTOBER 2022  
**Date of Issue :** 27 OCTOBER 2022

VIEW BY *Nathakorn P.*  
APPROVED BY *Nathakorn P.*  
NEXT CAL. DATE 28/10/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL22246  
Job No. : VC65AC0090  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-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).

Continuation of Calibration Certificate

Cert. No. : ACL22246

Job No. : VC65AC0090

Pages : 3 of 8

**Summary of Measurement Result :**

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



## Continuation of Calibration Certificate

Cert. No. : ACL22246

Job No. : VC65AC0090

Pages : 4 of 8

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

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

**2. Self-generated noise**

## 2.1 Normal test

Measured Value ( dB )
16.4

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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.0	1.0	1.0	±5.0

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**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	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



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## 7. Level linearity on the reference level range

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

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**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lcpeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	135.9	-0.5	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0



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## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22191

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## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597156 / 170403 / 72904  
**ID No.:** BKK\_FS0994

**Condition As Found :** GOOD

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

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

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

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	4/9/23

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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



## Continuation of Calibration Certificate

Cert. No. : ACL22191

Job No. : VC65AC0081

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Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-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).

Continuation of Calibration Certificate

Cert. No. : ACL22191  
Job No. : VC65AC0081  
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**Summary of Measurement Result :**

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