

# ภาคผนวก จ

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ใบรับรองการสอบเทียบเครื่องมือ

### รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	BKK_FS0367	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0369	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0173	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0185	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0399	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0187	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0400	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0463	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0255	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS1092	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0453	5-Jan-23	5-Jul-23	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0462	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0254	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	BKK_FS1091	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO <sub>2</sub> Analyzer	RYG_FS0452	4-Jan-23	4-Jul-23	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0087	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0081	18-Jan-23	18-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0089	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0143	5-Jan-23	5-Jul-24	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0025	25-Jan-23	25-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0024	16-Dec-22	16-Dec-23	12
Noise	Leq 5 min	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 5 min	Sound Level Meter	RYG_FS0025	25-Jan-23	25-Jan-24	12
Noise	Leq 5 min	Sound Level Meter	RYG_FS0024	16-Dec-22	16-Dec-23	12
Noise	Noise Annoyance	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Noise Annoyance	Sound Level Meter	RYG_FS0025	25-Jan-23	25-Jan-24	12
Noise	Noise Annoyance	Sound Level Meter	RYG_FS0024	16-Dec-22	16-Dec-23	12
Noise	Noise Annoyance	Sound Level Meter	RYG_FS0026	25-Jan-23	25-Jan-24	12
Noise	Noise Annoyance	Sound Level Meter	RYG_FS0027	13-Jan-23	13-Jan-24	12
Rayong Lab	Cyanide	SPECTROPHOTOMETER	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Phenol	SPECTROPHOTOMETER	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	27-Feb-23	27-Feb-24	12
Rayong Lab	Nitrate	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Ammonia Nitrogen	SPECTROPHOTOMETER	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	14-Feb-22	15-Aug-23	18
Rayong Lab	BOD	Incubator	RYG_EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	Temperature	Digital Thermometer With Sensor	RYG_FS0541	31-Aug-22	31-Aug-23	12
Rayong Lab	Temperature	Digital Thermometer With Sensor	RYG_FS0468	7-Sep-22	7-Sep-23	12
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Silver	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Silver	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Silver	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Barium	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Barium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Barium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Selenium	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Selenium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Selenium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Manganese	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Manganese	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Copper	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Copper	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Copper	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Lead	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Lead	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Lead	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Nickel	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Nickel	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Nickel	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Arsenic	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Arsenic	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Cadmium	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Zinc	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Zinc	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Zinc	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Trivalent Chromium	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Trivalent Chromium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Trivalent Chromium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Mercury	Mercury Analyzer	BKK_EL0128	30-Nov-22	30-Nov-23	12
Water Lab	Total Coliform	Autoclave	BKK_ML0037	21-Jan-22	22-Jul-23	18
Water Lab	Total Coliform	Incubator	BKK_ML0010	21-Jan-22	22-Jul-23	18
Water Lab	Total Coliform	Hot Air Oven	BKK_ML0013	21-Nov-22	21-May-24	18
Water Lab	Fecal Coliform	Autoclave	BKK_ML0037	21-Jan-22	22-Jul-23	18
Water Lab	Fecal Coliform	Incubator	BKK_ML0010	21-Jan-22	22-Jul-23	18
Water Lab	Fecal Coliform	Hot Air Oven	BKK_ML0013	21-Nov-22	21-May-24	18
Water Lab	Fecal Coliform	Water Bath	BKK_ML0056	20-May-22	20-May-23	12
Rayong Lab	Chloride	pH ISE Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Hardness	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Color	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Turbidity	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Conductivity	Conductivity meter	RYG_EN0029	23-Feb-22	24-Aug-23	18
Rayong Lab	Methyl Orange Alkalinity	pH meter	RYG_EN0183	27-Feb-23	27-Feb-24	12
Water Lab	Calcium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Calcium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Calcium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Aluminium	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Aluminium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Aluminium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Iron	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Iron	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Iron	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Manganese	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Manganese	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Standard Plate Count	Autoclave	BKK_ML0037	21-Jan-22	22-Jul-23	18
Water Lab	Standard Plate Count	Incubator	BKK_ML0010	21-Jan-22	22-Jul-23	18
Water Lab	Standard Plate Count	Hot Air Oven	BKK_ML0013	21-Nov-22	21-May-24	18
Water Lab	<i>Escherichia coli</i>	Autoclave	BKK_ML0037	21-Jan-22	22-Jul-23	18
Water Lab	<i>Escherichia coli</i>	Incubator	BKK_ML0010	21-Jan-22	22-Jul-23	18
Water Lab	<i>Escherichia coli</i>	Hot Air Oven	BKK_ML0013	21-Nov-22	21-May-24	18
Water Lab	<i>Escherichia coli</i>	Water Bath	BKK_ML0056	20-Apr-23	20-Apr-24	12
Rayong Lab	Nitrate	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Nitrite	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Silica	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Sulfate	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Formaldehyde	SPECTROPHOTOMETER	RYG_EN0037	27-Sep-22	27-Mar-24	18



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Phenol	SPECTROPHOTOMETER	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Water Lab	Total Phosphorus	Digestion Unit	BKK_EN0366	30-Jun-22	30-Jun-23	12
Water Lab	Total Phosphorus	Discrete analyzer	BKK_EN0037	5-Jan-23	5-Jan-24	12
Water Lab	Chromium	ICP-MS	BKK_EL0026	14-Jun-22	14-Dec-23	18
Water Lab	Chromium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Chromium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Sodium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Sodium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Silver	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Silver	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Silver	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Mercury	CVAFS	BKK_EL0011	7-Jun-22	6-Jun-23	12
Sludge	Copper	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Copper	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Copper	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Lead	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Lead	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Lead	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Manganese	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Manganese	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Nickel	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Nickel	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Nickel	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Arsenic	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Arsenic	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Cadmium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Cadmium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Zinc	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Sludge	Zinc	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Sludge	Zinc	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Sludge	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

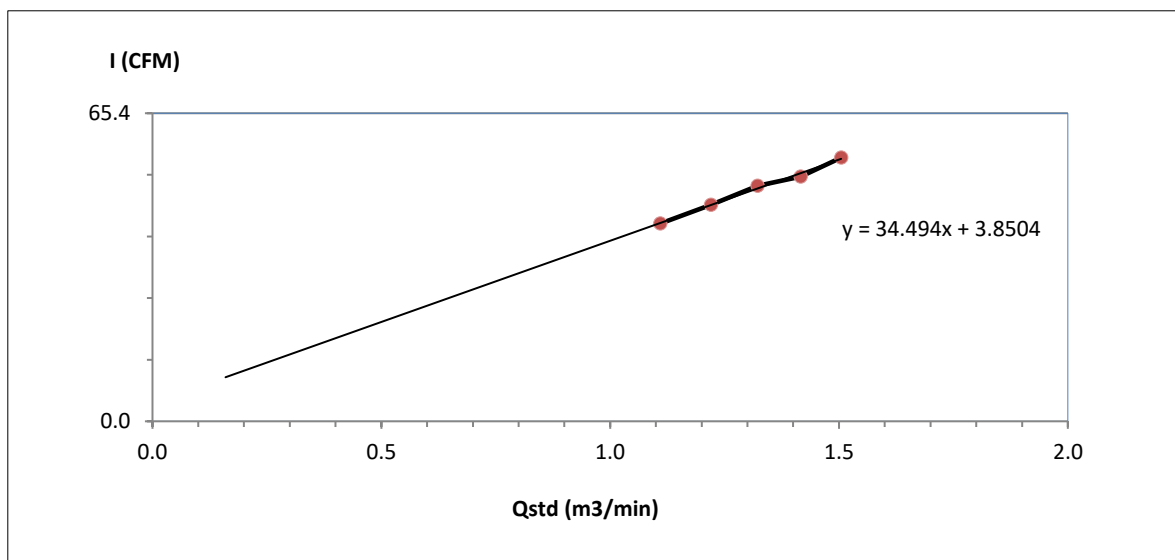
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Soil	Mercury	Mercury Analyzer	BKK_EL0128	30-Nov-22	30-Nov-23	12
Soil	Arsenic	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Arsenic	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Cadmium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Cadmium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Lead	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Lead	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Lead	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Manganese	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Manganese	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Manganese	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Nickel	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Nickel	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Nickel	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Selenium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Selenium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Selenium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Zinc	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Soil	Zinc	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Soil	Zinc	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Soil	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดโคกอุดมดี (A1)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	BKK_FS0367
CalibrationSheet No.:	C-280423-BKK_FS0367	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4162
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1096	42	Slope : 34.4936 Intercept : 3.8504 Correlation Coefficient : 0.9963
2	3.4	1.2206	46	
3	4.0	1.3222	50	
4	4.6	1.4165	52	
5	5.2	1.5047	56	



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

( Mr.Nontachai Uppathamp )  
Field Scientist(1)

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

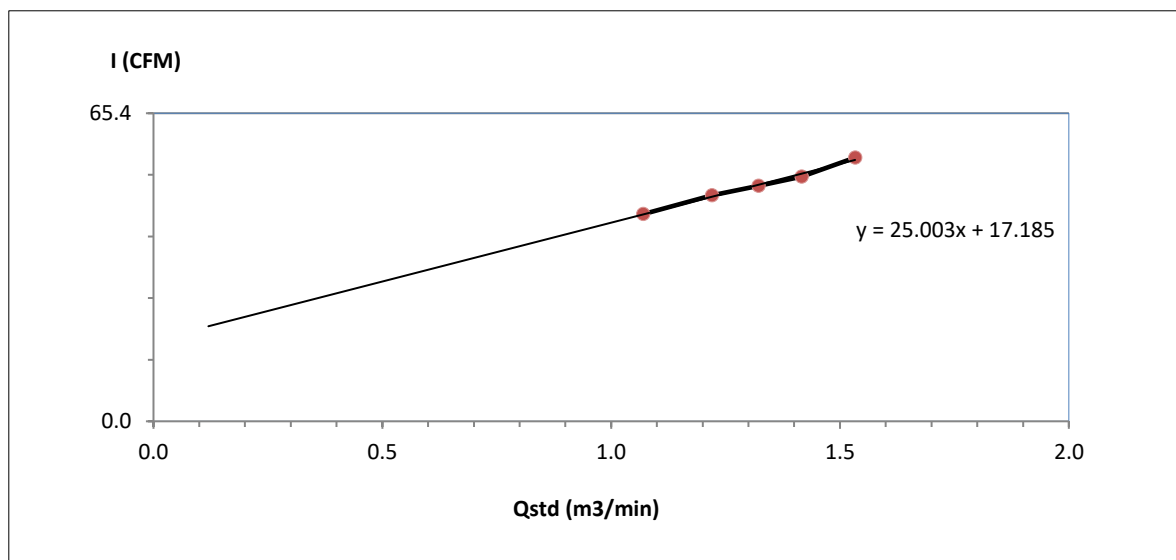
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดคลองสมบุรณ์ (A2)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	RYG_FS0174
CalibrationSheet No.:	C-280423-RYG_FS0174	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4800
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.6	1.0700	44	Slope : 25.0029 Intercept : 17.1848 Correlation Coefficient : 0.9953
2	3.4	1.2206	48	
3	4.0	1.3222	50	
4	4.6	1.4165	52	
5	5.4	1.5330	56	



Calibrated by N. Uppathamp

( Mr.Nontachai Uppathamp )  
Field Scientist(1)

Approved by N. Juntarupan

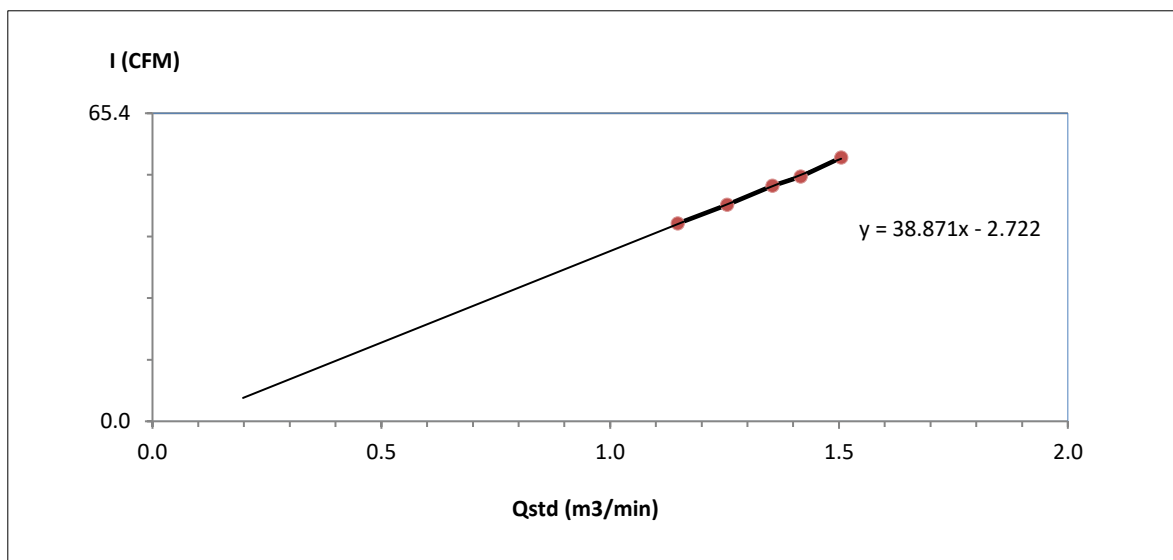
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดหนองหูล้าง (A3)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	BKK_FS0369
CalibrationSheet No.:	C-280423-BKK_FS0369	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4166
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.0	1.1478	42	Slope : 38.8708 Intercept : -2.7220 Correlation Coefficient : 0.9992
2	3.6	1.2554	46	
3	4.2	1.3544	50	
4	4.6	1.4165	52	
5	5.2	1.5047	56	



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

( Mr.Nontachai Uppathamp )  
Field Scientist(1)

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

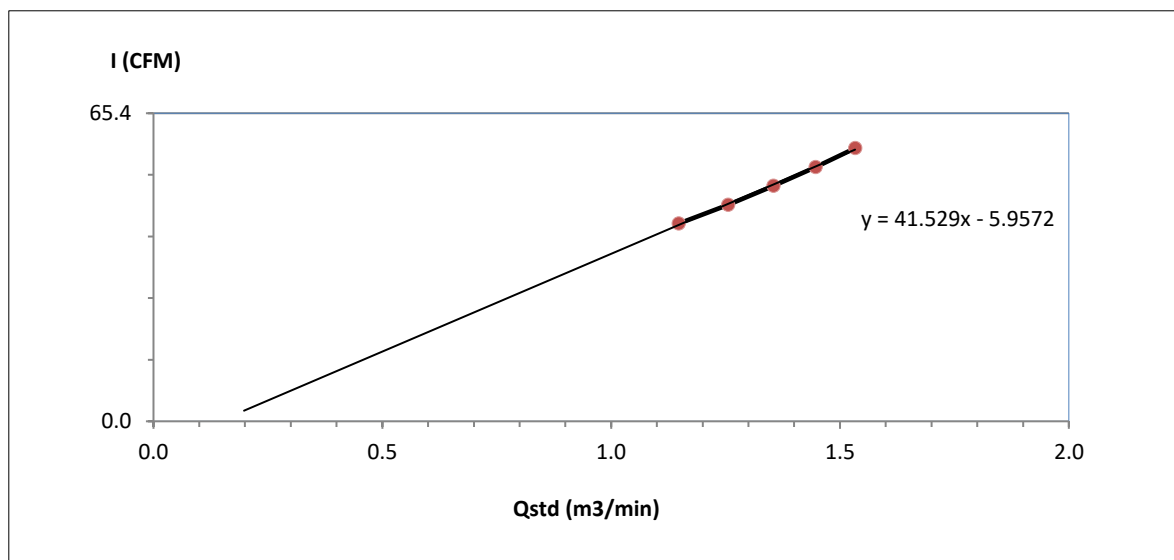
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดหนองเกตุ (A4)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	RYG_FS0173
CalibrationSheet No.:	C-280423-RYG_FS0173	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4799
Calibrator Model :	TE-5028A	Calibrator Slope :	1.50765
Calibrator S/N :	1166	Calibrator Intercept :	-0.02043

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	3.0	1.1478	42	Slope : 41.5292 Intercept : -5.9572 Correlation Coefficient : 0.9991
2	3.6	1.2554	46	
3	4.2	1.3544	50	
4	4.8	1.4465	54	
5	5.4	1.5330	58	



Calibrated by N. Uppathamp

( Mr.Nontachai Uppathamp )  
Field Scientist(1)

Approved by N. Juntarupan

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

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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

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



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**

REVIEW BY	Thantall.
APPROVED BY	D. [Signature]
NEXT CAL. DATE	01/03/24

# Certificate of Calibration

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

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

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

Calibrated By :	Mr.Chonchai Inthana	Calibration
Calibration Date :	Wednesday, March 01, 2023	Procedure No. : This calibration was conducted by
		Using in-house calibration procedure number (WI-003)
		Based on UKAS LAB 14 : 2019

Metrological data :	Ambients Conditions:
Capacity : 150 g Readability : 0.0001 g	Temperature : 24.2 °C ± 5.0 °C
	Humidity : 60.0 % RH ± 10.0 % RH
	Pressure : — ± —

**Reasons for calibration**
☐ New Installation
 ☐ Service / Repaired
 ☒ Re-calibration/ Maintenance

**Equipment Condition:**
☒ Good Operate
 ☐ Fair

## Measurement Method UKAS Publication Ref :Lab 14

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

## Traceability:

Model Number	Description	Traceability	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.

Mr.chonchai Inthana(Technical Manager)

S  
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 : LA130S-F

Description : Analytical Balance

Serial Number : 25409664

ID No. : RYG\_EN0001

Manufacturer : Sartorius

Certificate No. : 23BCI0110

Issued Date : Friday, March 03, 2023

Reference No. : 204833

Page No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

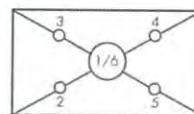
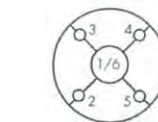
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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

### Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of 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	0.0000
3	-0.0001
4	0.0001
5	0.0000
6	-

### Linearity

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

Tolerance 0.0002 g

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

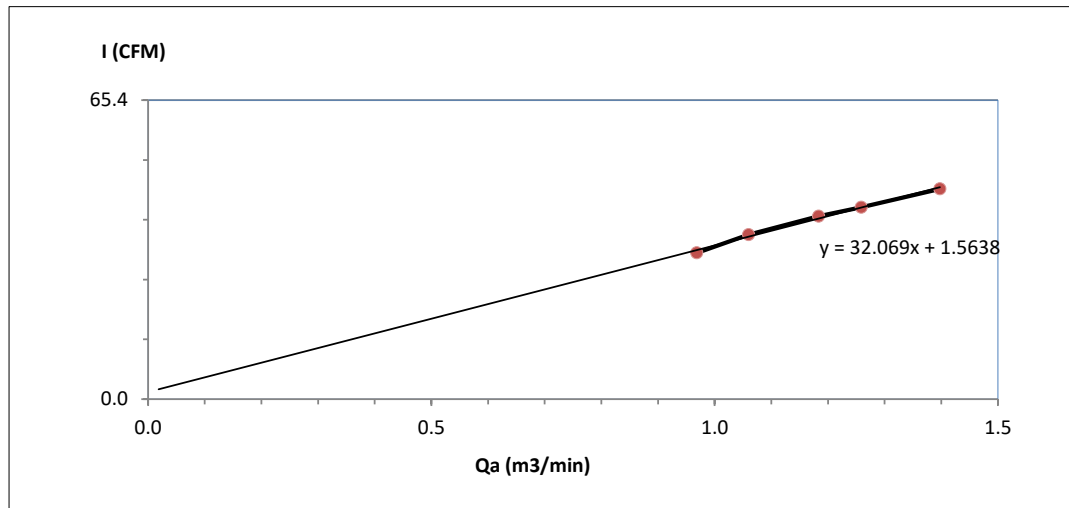
End of Report.



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดโคกอุดมดี (A1)	Temperature ( °C) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	RYG_FS0185
CalibrationSheet No.:	C-280423-RYG_FS0185	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4793
Calibrator Model :	TE-5028A	Calibrator Slope :	0.94434
Calibrator S/N :	1166	Calibrator Intercept :	-0.01292

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.969	32	Slope : 32.0688 Intercept : 1.5638 Correlation Coefficient : 0.9958
2	2.4	1.060	36	
3	3.0	1.183	40	
4	3.4	1.259	42	
5	4.2	1.398	46	



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

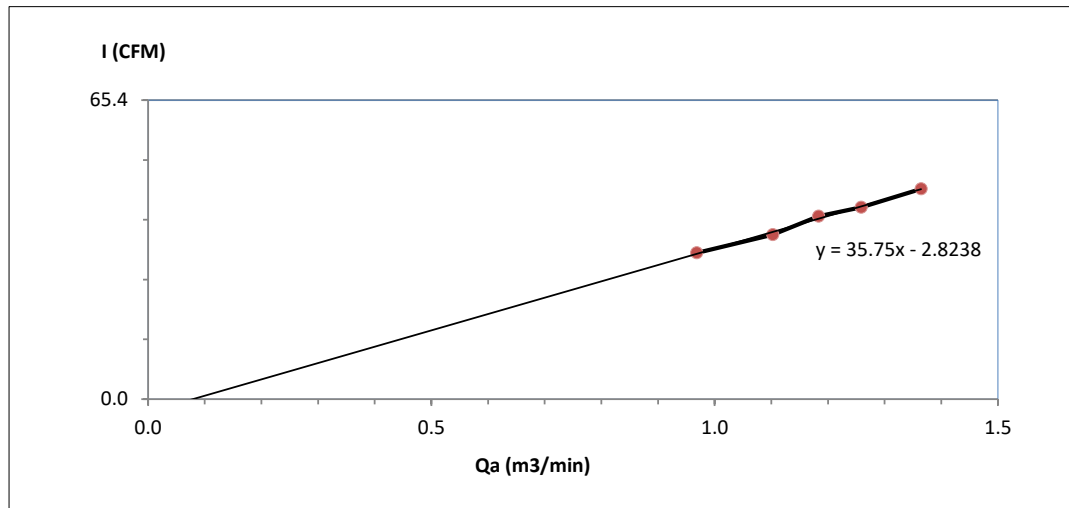
Approved by : N. Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดคลองสมบูรณ์ (A2)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	RYG_FS0399
CalibrationSheet No.:	C-280423-RYG_FS0399	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	5683
Calibrator Model :	TE-5028A	Calibrator Slope :	0.94434
Calibrator S/N :	1166	Calibrator Intercept :	-0.01292

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.969	32	Slope : 35.7502 Intercept : -2.8238 Correlation Coefficient : 0.9970
2	2.6	1.102	36	
3	3.0	1.183	40	
4	3.4	1.259	42	
5	4.0	1.364	46	



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

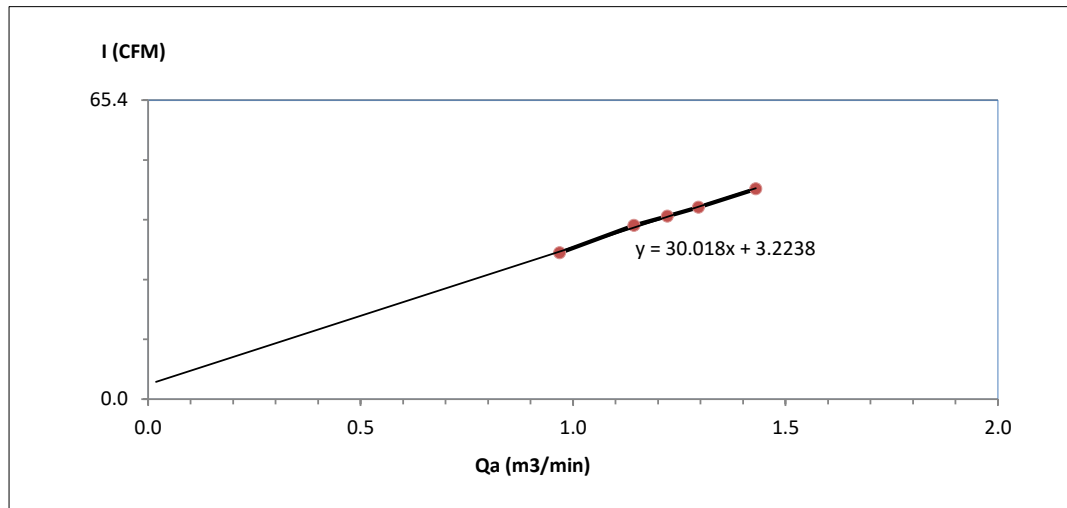
Approved by : N. Noppong Juntarupan  
 (Mr. Noppong Juntarupan)  
 Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดหนองหูล้าง (A3)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	RYG_FS0187
CalibrationSheet No.:	C-280423-RYG_FS0187	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4795
Calibrator Model :	TE-5028A	Calibrator Slope :	0.94434
Calibrator S/N :	1166	Calibrator Intercept :	-0.01292

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.969	32	Slope : 30.0183 Intercept : 3.2238 Correlation Coefficient : 0.9984
2	2.8	1.144	38	
3	3.2	1.222	40	
4	3.6	1.295	42	
5	4.4	1.430	46	



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

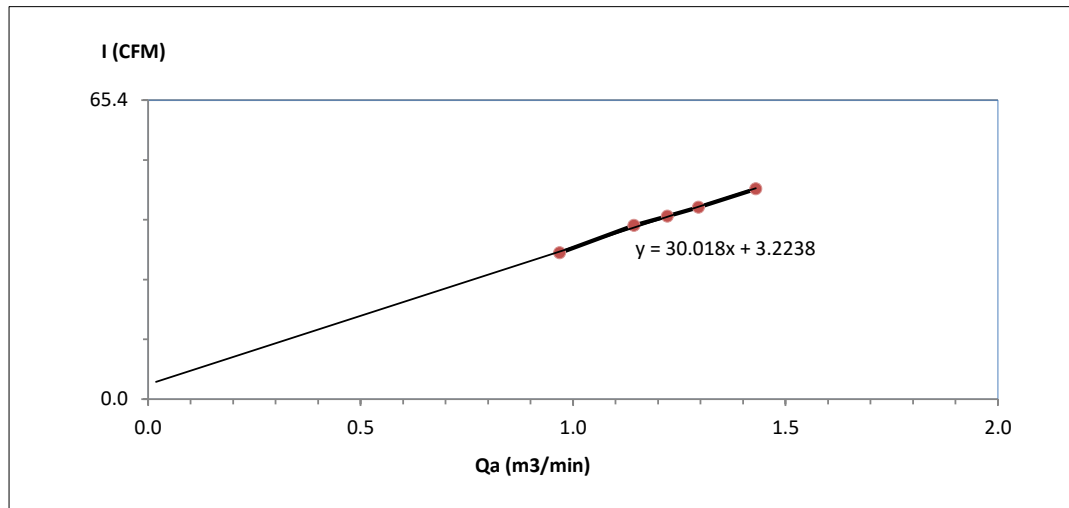
Approved by : N. Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

Project Site :	Rojana Industrial Park Prachinburi Co., Ltd.	Barometric Pressure (mm Hg) :	754
Calibrate Location :	วัดหนองเกตุ (A4)	Temperature ( °C ) :	34
Calibrate Date :	28-Apr-23	High Volume ID :	RYG_FS0400
CalibrationSheet No.:	C-280423-RYG_FS0400	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	5691
Calibrator Model :	TE-5028A	Calibrator Slope :	0.94434
Calibrator S/N :	1166	Calibrator Intercept :	-0.01292

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.969	32	Slope : 30.0183 Intercept : 3.2238 Correlation Coefficient : 0.9984
2	2.8	1.144	38	
3	3.2	1.222	40	
4	3.6	1.295	42	
5	4.4	1.430	46	



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

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

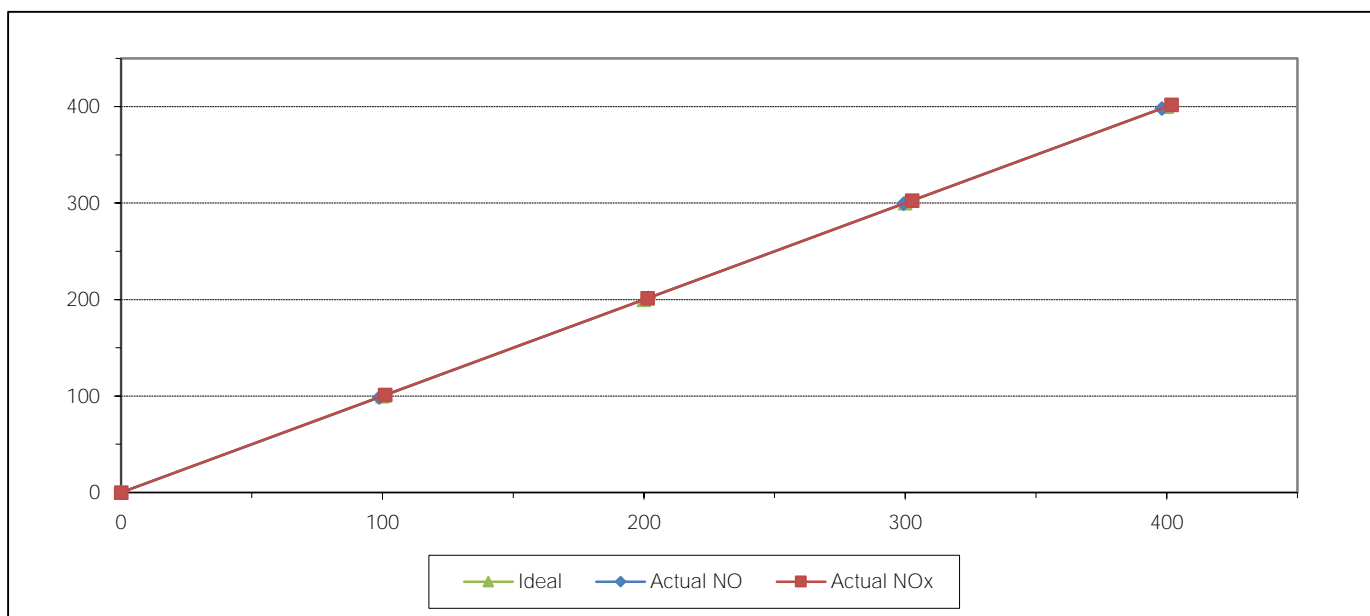


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer HORIBA  
Serial No. R06K0177  
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 RYG\_FS0463  
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	98.80	-1.20	-1.20	101.10	1.10	1.10
2	200.00	201.80	1.80	0.90	201.50	1.50	0.75
3	300.00	299.40	-0.60	-0.20	302.60	2.60	0.87
4	400.00	398.10	-1.90	-0.47	401.90	1.90	0.47
AVERAGE (%)				-0.18			0.66



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager

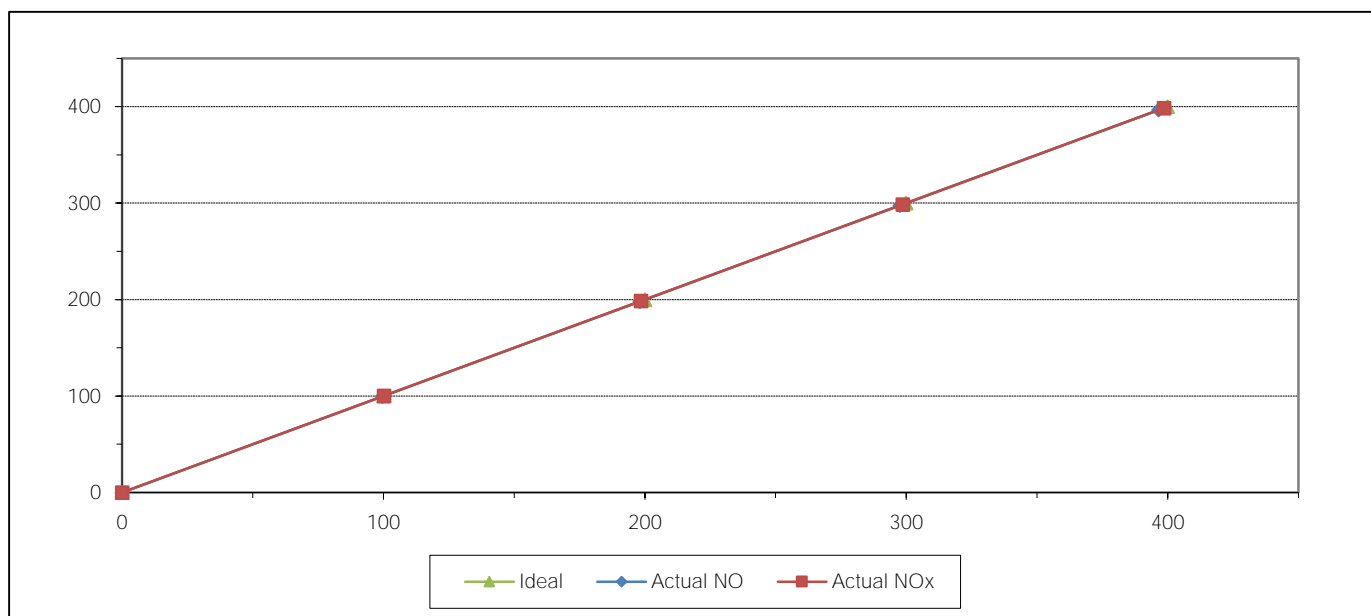


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer Teledyne API  
Serial No. 2197  
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 RYG\_FS0255  
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	99.60	-0.40	-0.40	100.20	0.20	0.20
2	200.00	198.10	-1.90	-0.95	198.50	-1.50	-0.75
3	300.00	297.50	-2.50	-0.83	298.70	-1.30	-0.43
4	400.00	396.50	-3.50	-0.88	398.60	-1.40	-0.35
AVERAGE (%)				-0.59			-0.25



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager

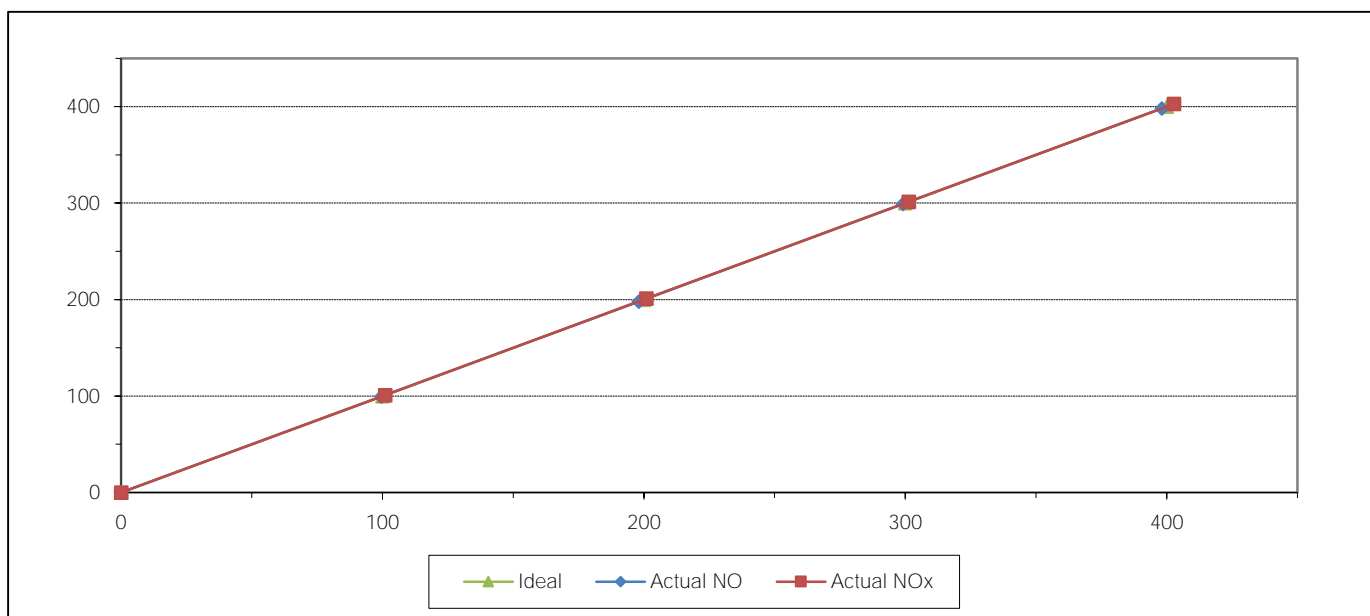


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer HORIBA  
Serial No. XLTWRBSJ  
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\_FS1092  
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	99.70	-0.30	-0.30	101.00	1.00	1.00
2	200.00	198.10	-1.90	-0.95	201.00	1.00	0.50
3	300.00	299.10	-0.90	-0.30	301.40	1.40	0.47
4	400.00	398.20	-1.80	-0.45	402.80	2.80	0.70
AVERAGE (%)				-0.38			0.55



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager

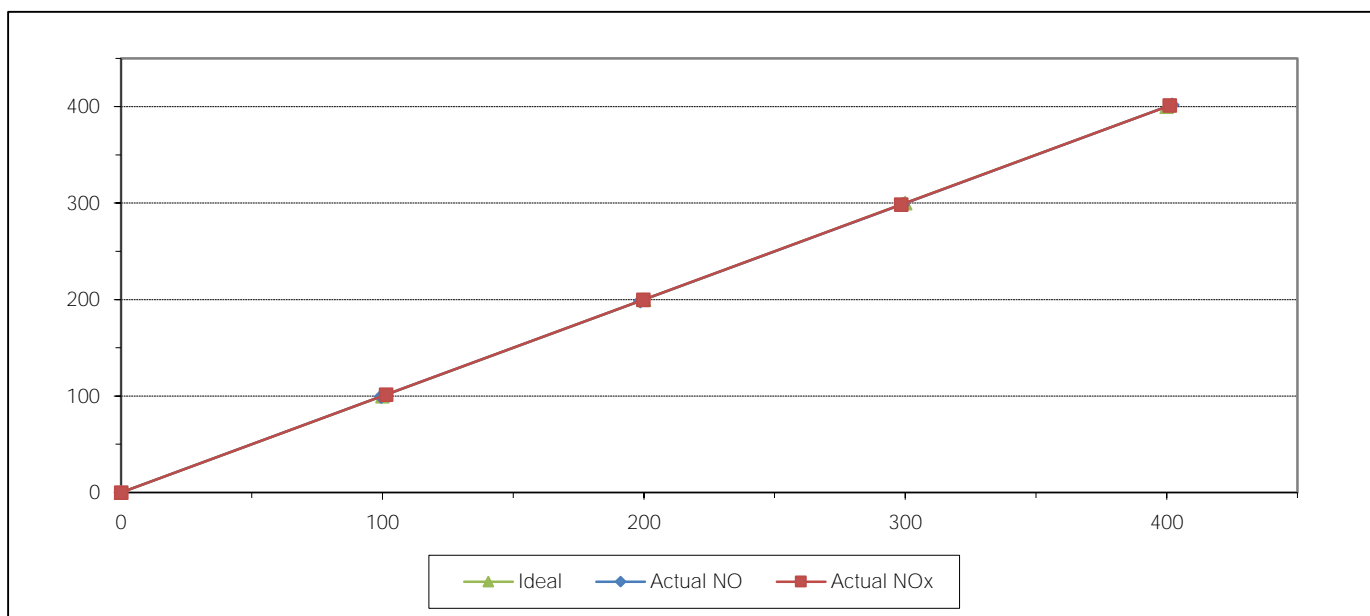


## MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23  
Manufacturer HORIBA  
Serial No. AWXG87CR  
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 RYG\_FS0453  
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	99.60	-0.40	-0.40	101.40	1.40	1.40
2	200.00	198.60	-1.40	-0.70	199.80	-0.20	-0.10
3	300.00	299.00	-1.00	-0.33	298.50	-1.50	-0.50
4	400.00	402.10	2.10	0.53	401.20	1.20	0.30
AVERAGE (%)				-0.16			0.24



Calibrated By

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

Approved By

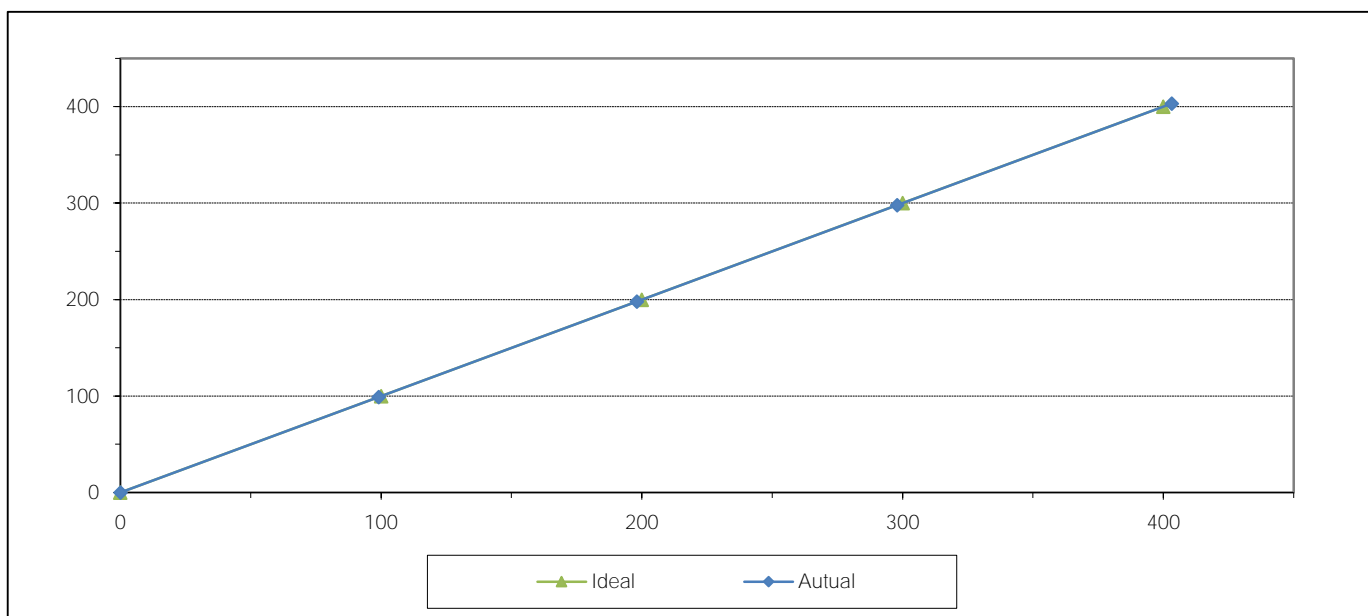
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

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

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



Calibrated By

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

Approved By

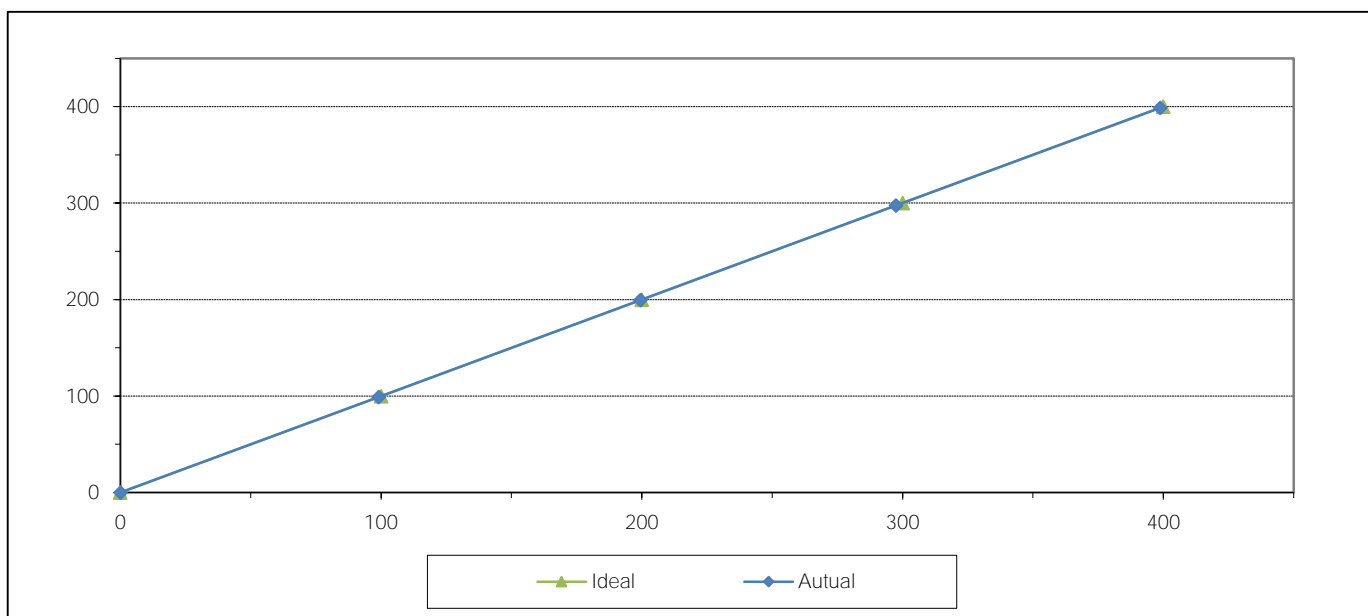
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

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

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



Calibrated By

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

Approved By

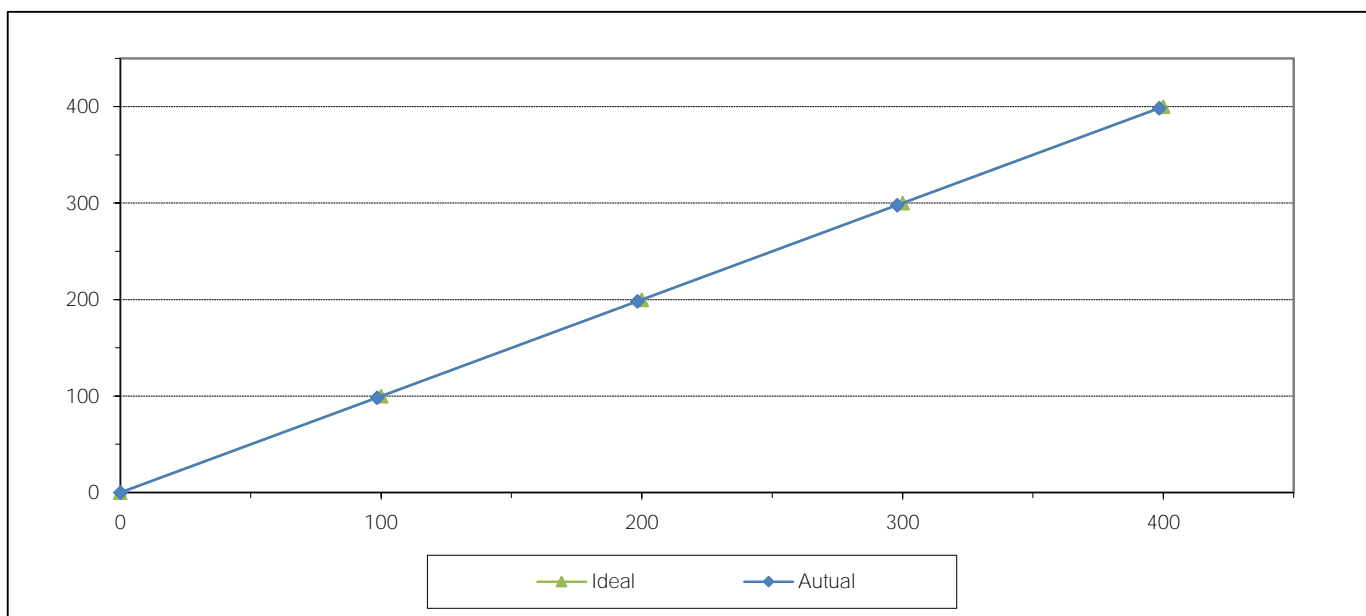
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	6BVW9P1K	Equipment ID	BKK_FS1091
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.50	-1.50	-1.50
2	200.00	198.30	-1.70	-0.85
3	300.00	297.90	-2.10	-0.70
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)				-0.67



Calibrated By

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

Approved By

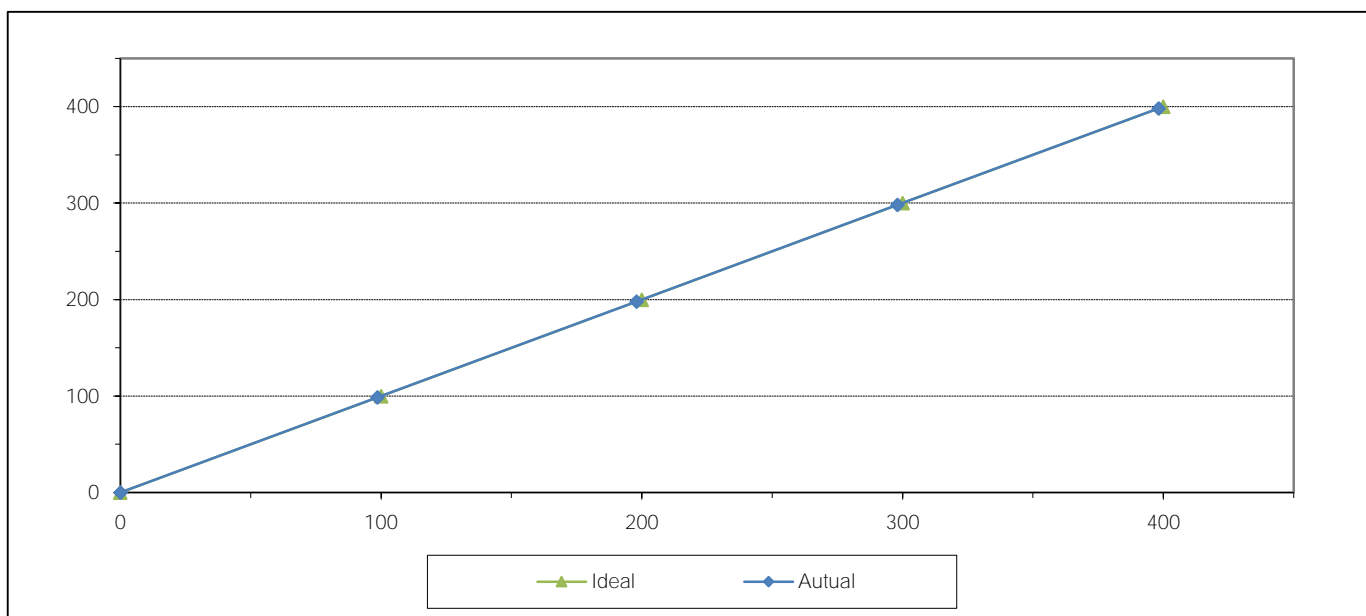
( Mr.Sarayuth Jittranont )  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

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

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



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager



JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd  
63/14-15, 67/35-36  
Petchkasem 7,7/1, Rd.Watthapra, Bangkokyai,  
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E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department.

REVIEW BY

Warakorn P.

APPROVED BY

47/6

NEXT CAL DATE

19/4/24

Certificate Number

CL-010-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-25DL  
**SERIAL NUMBER** : Sensor: -  
Data logger: A4986  
**ID NUMBER** : RYG\_FS0087  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 16 Jan 2023  
**MEASUREMENT DATE** : 19 Jan 2023  
**ISSUE DATE** : 20 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

**CALIBRATION CONDITION** : 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 (23.5)°C, (47.4) %RH and (1015.6) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved signatory:

25/Jan

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	$D^{\circ}_{std}$ Degree (°)	$D^{\circ}_{uuc}$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
5.02	0.000	0	0	0.58
	45.000	43	-2	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.74
	180.000	179	-1	0.74
	225.000	225	0	0.68
	270.000	273	3	0.58
	315.000	319	4	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\*\*\*





JIRANATEE ASSOCIATES CO.,LTD.

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

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-010-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-25DL  
**SERIAL NUMBER** : Sensor: -  
Data logger: A4986  
**ID NUMBER** : RYG\_FS0087  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

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

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<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 (23.6) °C, (55.3) %RH and (1013.5) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol

### 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>

### Calibration procedure:

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

### Traceability:

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

### Uncertainty of Measurement:

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



Approved signatory: \_\_\_\_\_

Mr. Parinya Booncharoen  
Calibration Department Manager

**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	23.68	23.60	0.8	-0.2	0.15
2.033	23.54	23.60	1.8	-0.2	0.16
3.046	23.68	23.60	2.9	-0.1	0.19
4.136	23.66	23.60	3.9	-0.2	0.20
5.03	23.50	23.60	4.9	-0.1	0.20
5.98	23.50	23.60	5.9	-0.1	0.18
7.05	23.36	23.60	7.0	-0.1	0.18
8.18	23.54	23.60	8.0	-0.2	0.20
9.10	23.30	23.60	8.9	-0.2	0.20
10.10	23.50	23.60	10.0	-0.1	0.19
11.14	23.28	23.60	11.1	-0.1	0.22
12.12	23.40	23.60	11.9	-0.2	0.21
13.19	23.10	23.60	13.0	-0.2	0.26
14.25	23.46	23.60	14.0	-0.2	0.32
15.26	23.10	23.60	15.0	-0.2	0.23
16.31	23.26	23.60	16.2	-0.1	0.29

**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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CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

REVIEW BY	Narakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	18/7/24

Certificate Number
CL-009-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02E  
Data logger: 110-WS-16N  
**SERIAL NUMBER** : Sensor: -  
Data logger: 1159  
**ID NUMBER** : RYG\_FS0081  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

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

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<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 (23.5) °C, (52.2) %RH and (1014.5) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol

### 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>



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

**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.

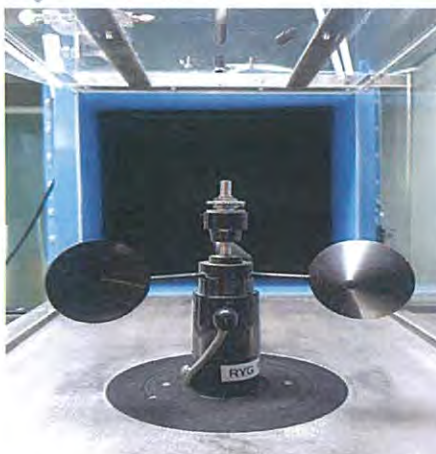
$V_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{UUC}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.981	23.56	23.45	0.8	-0.2	0.15
2.030	23.40	23.45	1.9	-0.2	0.16
3.049	23.50	23.45	2.9	-0.2	0.17
4.129	23.50	23.45	3.9	-0.3	0.20
5.01	23.50	23.45	4.8	-0.2	0.17
5.97	23.54	23.45	5.7	-0.3	0.17
7.05	23.42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

**Remark:**

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

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-009-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02E  
Data logger: 110-WS-16N  
**SERIAL NUMBER** : Sensor: -  
Data logger: 1159  
**ID NUMBER** : RYG\_FS0081  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

### Calibration procedure:

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

### Traceability:

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

### Uncertainty of Measurement:

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

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

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

**CALIBRATION CONDITION** : Wind tunnel cross-section area<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 (23.8)°C, (47.3) %RH and (1014.8) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



### Approved signatory:

*25/Jan/23*

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

**Remark:**

<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\*\*\*



JIRANATEE ASSOCIATES CO.,LTD.

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Accredited calibration laboratory  
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NSC-TISI-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

REVIEW BY	<i>Narakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	19/7/24

Certificate Number

CL-011-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalyx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-25DL  
**SERIAL NUMBER** : Sensor: -  
Data logger: A4987  
**ID NUMBER** : RYG\_FS0089  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 16 Jan 2023  
**MEASUREMENT DATE** : 19 Jan 2023  
**ISSUE DATE** : 20 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<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 (24.1)°C, (54.3) %RH and (1015.2) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: .....

*[Signature]*  
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	$D^6_{std}$ Degree (°)	$D^7_{uuc}$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
5.03	0.000	0	0	0.58
	45.000	41	-4	0.68
	90.000	88	-2	0.74
	135.000	133	-2	0.58
	180.000	180	0	0.74
	225.000	228	3	0.74
	270.000	273	3	0.68
	315.000	316	1	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\*\*\*





JIRANATEE ASSOCIATES CO.,LTD.

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Web site: www.jiranatee.com

Accredited calibration laboratory  
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NSC-TISI-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-011-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalyx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-25DL  
**SERIAL NUMBER** : Sensor: -  
Data logger: A4987  
**ID NUMBER** : RYG\_FS0089  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) co., ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

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

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<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 (23.5) °C, (52.8) %RH and (1014.1) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol

### 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>

### Calibration procedure:

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

### Traceability:

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

### Uncertainty of Measurement:

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

Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager



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

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

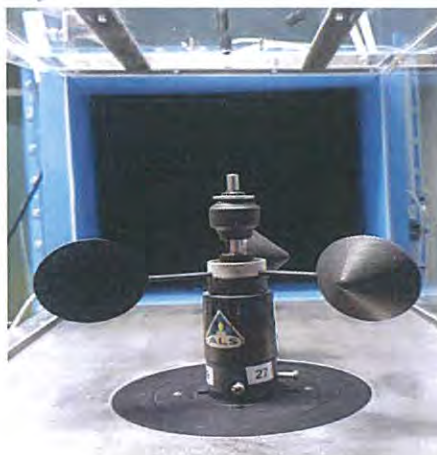
$v_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{uuc}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.983	23.50	23.45	0.8	-0.2	0.17
2.035	23.44	23.45	1.9	-0.1	0.16
3.049	23.50	23.45	2.9	-0.2	0.19
4.136	23.50	23.45	3.9	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.9	-0.1	0.19
7.07	23.40	23.45	7.0	-0.1	0.19
8.18	23.50	23.45	8.0	-0.2	0.19
9.10	23.26	23.45	9.0	-0.1	0.20
10.09	23.44	23.45	9.9	-0.1	0.21
11.15	23.30	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.25
13.20	23.22	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.1	-0.1	0.24
15.24	23.24	23.45	15.0	-0.3	0.26
16.31	23.24	23.45	16.1	-0.2	0.24

**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.

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

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

Air speed measurement laboratory  
Calibration services department.

REVIEW BY	Nanakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	5/7/24

Certificate Number

CL-002-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: WS-25DL  
**SERIAL NUMBER** : Sensor: -  
Data logger: A4562  
**ID NUMBER** : BKK\_FS0143  
**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.

### Calibration procedure:

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

### Traceability:

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

### Uncertainty of Measurement:

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

**RECEIVED DATE** : 28 Dec 2022  
**MEASUREMENT DATE** : 05 Jan 2023  
**ISSUE DATE** : 09 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

**CALIBRATION CONDITIONS** : Wind tunnel cross-section area<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 (24.0) °C, (50.4) %RH and (1014.5) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol

### 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>



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

**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.

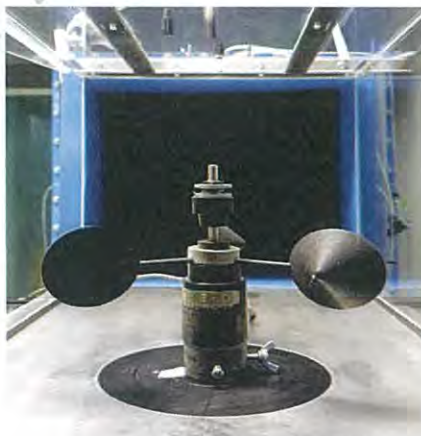
$v_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{uuc}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.989	24.10	24.00	0.7	-0.3	0.18
2.034	23.96	24.00	1.7	-0.3	0.16
3.051	24.06	24.00	2.9	-0.2	0.29
4.138	24.00	24.00	3.9	-0.2	0.19
4.99	24.00	24.00	4.8	-0.1	0.26
5.98	24.00	24.00	5.9	-0.1	0.18
7.05	23.90	24.00	6.9	-0.1	0.21
8.18	23.90	24.00	8.0	-0.2	0.21
9.09	23.72	24.00	9.1	0.0	0.30
10.09	23.80	24.00	9.9	-0.1	0.24
11.16	23.80	24.00	11.1	-0.1	0.28
12.13	23.90	24.00	12.1	0.0	0.28
13.21	23.90	24.00	13.2	0.0	0.34
14.27	23.96	24.00	14.4	0.1	0.22
15.26	23.88	24.00	15.1	-0.1	0.27
16.32	24.00	24.00	16.4	0.1	0.28

**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 due to imaging geometry.

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-002-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: WS-25DL  
**SERIAL NUMBER** : Sensor: -  
Data logger: A4562  
**ID NUMBER** : BKK\_FS0143  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 28 Dec 2022  
**MEASUREMENT DATE** : 06 Jan 2023  
**ISSUE DATE** : 09 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

<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 (23.9)°C, (50.1 %RH and (1015.7) 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>

### Calibration procedure:

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

### Traceability:

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

### Uncertainty of Measurement:

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

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 (°)
4.98	0.000	0	0	0.58
	45.000	41	-4	0.74
	90.000	87	-3	0.74
	135.000	134	-1	0.74
	180.001	182	2	0.74
	225.000	228	3	0.68
	270.000	272	2	0.74
	315.000	318	3	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\*\*\*

# 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. : ACC22023

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-74  
**Serial No.:** 34178123  
**ID No.:** RYG\_FS0215

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 :** 22 AUGUST 2022  
**Calibration Date :** 31 AUGUST 2022  
**Date of Issue :** 02 SEPTEMBER 2022

REVIEW BY	Nathakorn P.
APPROVED BY	[Signature]
NEXT CAL. DATE	31/8/23

**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. : ACC22023

Job No. : VC65AC0077

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. : ACC22023

Job No. : VC65AC0077

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	94.04	0.04	0.14	0.40

**2. Frequency**

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

**3. Total distortion**

Measured value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1.70	0.10	3.0

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor  $k = 2$  or any value following calculation, providing a 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. : ACL23077

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00233184 / 144837 / 23232  
**ID No.:** RYG\_FS0025

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 :** 24 JANUARY 2023  
**Calibration Date :** 25-26 JANUARY 2023  
**Date of Issue :** 27 JANUARY 2023



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( 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. : ACL23077

Job No. : VC66AC0031

Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<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. : ACL23077**  
**Job No. : VC66AC0031**  
**Pages : 3 of 8**

**Summary of Measurement Result :**

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

## Continuation of Calibration Certificate

Cert. No. : ACL23077

Job No. : VC66AC0031

Pages : 4 of 8

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

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

**2. Self-generated noise**

## 2.1 Normal test

Measured Value ( dB )
14.2

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

Frequency Weighting	Measured value ( dB )
A - weight	10.8
C - weight	17.1
Flat	22.8

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.0	-0.9	-0.8	±5.0

Continuation of Calibration Certificate

**Cert. No. : ACL23077**  
**Job No. : VC66AC0031**  
**Pages : 5 of 8**

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

Weighting network response with relative to 1 kHz.

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

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

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

**6. Long - term stability**

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	94.0	94.1	0.1	± 0.3

## Continuation of Calibration Certificate

Cert. No. : ACL23077

Job No. : VC66AC0031

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	104.1	0.1	$\pm 1.1$
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	29.9	-0.1	$\pm 1.1$
29.0	29.0	0.0	$\pm 1.1$
28.0	27.9	-0.1	$\pm 1.1$
27.0	27.0	0.0	$\pm 1.1$
26.0	25.9	-0.1	$\pm 1.1$
25.0	24.9	-0.1	$\pm 1.1$

Continuation of Calibration Certificate

**Cert. No. : ACL23077**  
**Job No. : VC66AC0031**  
**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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	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. : ACL23077  
Job No. : VC66AC0031  
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	89.7	0.2	±1.5

**12. High level stability**

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

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

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

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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

Cert. No. : ACL22295

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00233183 / 144835 / 23230  
**ID No.:** RYG\_FS0024

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 :** 07 DECEMBER 2022  
**Calibration Date :** 16-20 DECEMBER 2022  
**Date of Issue :** 21 DECEMBER 2022

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

**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. : ACL22295

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. : ACL22295

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. : ACL22295

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 )
19.3

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

Frequency Weighting	Measured value ( dB )
A - weight	14.8
C - weight	20.6
Flat	26.5

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

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22295  
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	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

**6. Long - term stability**

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

## Continuation of Calibration Certificate

Cert. No. : ACL22295

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	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.8	-0.2	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

Continuation of Calibration Certificate

**Cert. No. : ACL22295**  
**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	128.1	0.1	±1.0

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, Lcpeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	135.6	-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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL22295

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		
89.6	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

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Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



Cert. No. : ACL23082

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00734220 / 145272 / 34370  
**ID No.:** RYG\_FS0026

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
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 :** 24 JANUARY 2023  
**Calibration Date :** 25-26 JANUARY 2023  
**Date of Issue :** 27 JANUARY 2023



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

  
( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

Cert. No. : ACL23082

Job No. : VC66AC0031

Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

<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. : ACL23082**

**Job No. : VC66AC0031**

**Pages : 3 of 8**

**Summary of Measurement Result :**

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

Continuation of Calibration Certificate

**Cert. No. : ACL23082**

**Job No. : VC66AC0031**

**Pages : 4 of 8**

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

2.1 Normal test

Measured Value ( dB )
15.6

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

Frequency Weighting	Measured value ( dB )
A - weight	12.0
C - weight	18.3
Flat	24.1

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			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	-1.6	-1.5	-1.5	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL23082

Job No. : VC66AC0031

Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

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

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

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	94.0	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. : ACL23082**

**Job No. : VC66AC0031**

**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	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

Continuation of Calibration Certificate

**Cert. No. : ACL23082**  
**Job No. : VC66AC0031**  
**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	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

**10. Peak C sound level**

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

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

**Continuation of Calibration Certificate**

**Cert. No. : ACL23082**

**Job No. : VC66AC0031**

**Pages : 8 of 8**

**11. Overload indication**

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

**12. High level stability**

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

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

**End of Calibration Certificate**

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL23041

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00734221 / 145286 / 34371  
**ID No.:** RYG\_FS0027

**Condition As Found :** GOOD

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

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

**Received Date :** 06 JANUARY 2023  
**Calibration Date :** 13-18 JANUARY 2023  
**Date of Issue :** 19 JANUARY 2023



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

(  )  
( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

Cert. No. : ACL23041  
Job No. : VC66AC0024  
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. : ACL23041**  
**Job No. : VC66AC0024**  
**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. : ACL23041

Job No. : VC66AC0024

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 )
17.1

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

Frequency Weighting	Measured value ( dB )
A - weight	13.4
C - weight	19.6
Flat	25.5

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	1.5	1.6	1.6	±5.0

Continuation of Calibration Certificate

**Cert. No. : ACL23041**  
**Job No. : VC66AC0024**  
**Pages : 5 of 8**

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

Weighting network response with relative to 1 kHz.

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

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

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

## Continuation of Calibration Certificate

Cert. No. : ACL23041

Job No. : VC66AC0024

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	38.9	-0.1	$\pm 1.1$
34.0	33.9	-0.1	$\pm 1.1$
30.0	29.9	-0.1	$\pm 1.1$
29.0	28.9	-0.1	$\pm 1.1$
28.0	27.9	-0.1	$\pm 1.1$
27.0	26.9	-0.1	$\pm 1.1$
26.0	25.9	-0.1	$\pm 1.1$
25.0	24.8	-0.2	$\pm 1.1$

Continuation of Calibration Certificate

**Cert. No. : ACL23041**  
**Job No. : VC66AC0024**  
**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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

**10. Peak C sound level**

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

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

Continuation of Calibration Certificate

Cert. No. : ACL23041  
Job No. : VC66AC0024  
Pages : 8 of 8

**11. Overload indication**

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.6	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** \_\_\_\_\_



# Certificate of Calibration

<b>Equipment:</b>	SPECTROPHOTOMETER	<b>Certificate No.:</b>	C06220464
<b>Model:</b>	DR6000	<b>Issued Date:</b>	27 September 2022
<b>Serial No. (or ID.):</b>	1627845 (RYG_EN0037)	<b>Job No.:</b>	KSPR2212224
<b>Manufacturer:</b>	HACH	<b>Page:</b>	1 of 3
<b>Condition:</b>	In Condition		

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

REVIEW BY N. Banet  
APPROVED BY D. [Signature]  
NEXT CAL. DATE 27/13/24

**Environment Condition:**

Temperature	23.1	°C	±
Humidity	65.4	%RH	±

3.2 %RH

**Calibration Place:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) ( Wet Chemistry )  
616/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand.


**Calibration By:** Mr. Chattuphon Foithong

**Calibration Date:** 27 September 2022

**The Method used:** In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

**Traceability:** This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 91418 and 91435  
The standard for Photometric Certificate No. 91441 and 101088  
The standard for Stray light Certificate No. 101041 and 101040  
The standard for Spectral resolution Certificate No. 101037

  
(Mr. Chattuphon Foithong)  
Person in charge

  
(Mr. Thalerngkeat Pounngam)  
Authorized signatory

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

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

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

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

**Calibration Results:**
**Without Adjustment**

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.4	0.21	0.14
536.66	536.7	-0.04	0.14
637.98	638.3	-0.32	0.14
748.48	748.8	-0.32	0.14
807.03	807.4	-0.37	0.13

**Photometric Accuracy (Absorbance)**

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5605	0.563	-0.0025	0.0045
	0.7334	0.737	-0.0036	0.0045
	1.0534	1.057	-0.0036	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5503	0.553	-0.0027	0.0045
	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6693	0.672	-0.0027	0.0045
	0.9604	0.964	-0.0036	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0046
	0.9823	0.983	-0.0007	0.0045

**Calibration Results:**
**Without Adjustment**
**Photometric Accuracy (Absorbance)**

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7423	0.744	-0.0017	0.0083
257 nm	0.0000	0.000	0.0000	0.0080
	0.8609	0.861	-0.0001	0.0084
313 nm	0.0000	0.000	0.0000	0.0080
	0.2895	0.292	-0.0025	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6381	0.638	0.0001	0.0080

**Stray light \***

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
260.67 +/- 0.11 nm	260.7	2.1	1.678
391.94 +/- 0.11 nm	391.9	1.7	1.770

**Spectral Resolution \***

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength ( nm )	268.60	266.63	1.39	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance ( A )	0.4810	0.3176		
Absorbance ( A )	0.373	0.268		

\* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

**The End of Certificate**

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
27 Sep 2022			27 Sep 2022		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Swicth)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Spectrophotometer			
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	656.1 ได้ 656.1 nm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		pH Meter and Conductivity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด ( Electrode and Connection Cable )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		Turbidimeter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic titrator			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพิ่มเติม/ข้อแนะนำ :

Mr. Chattuphon Foithong

Service Engineer



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TEL. 0-2717-3000-29 FAX. 0-2719-9484

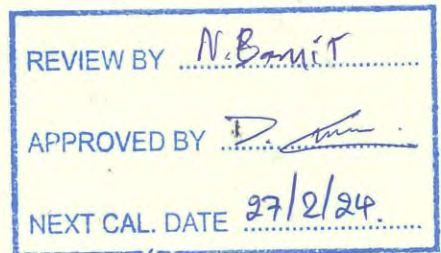


Cert.No.: 23CH275

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** pH Meter  
**Manufacturer :** Mettler Toledo  
**Model :** SevenCompact S220  
**Serial No. :** C104059460  
**ID No. :** RYG\_EN0183  
**Condition As-Received:** Used Item  
**Received Date :** 24 February 2023  
**Calibration Date :** 27 February 2023  
**Reference :** 2302-0886DSC-2  
**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd.  
(Rayong Branch)  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand



**Ambient Temperature :** (25 ± 2.5) °C  
**Relative Humidity :** (50 ± 15) %  
**Calibration Procedure :** In - house method :  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

**Calibrated by :** Walalak Sirithean

**Approved by :**

Approved Signatory

- ( ) Malee Butkruea  
(✓) Saithip Meangmai  
( ) Warakorn Lernagtrakul

**Issue Date :**

28 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0051538



Cert.No.: 23CH275

Page.: 2 of 3

**Condition of this calibration result**

1. Reference Standard Instrument : -

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

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

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

**Calibration Results**

**Function : mV Measurement**

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( $\pm$ mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: C104059460	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

*Saeed*



Cert.No.: 23CH275

Page.: 3 of 3

**Calibration Results****Function : pH Measurement**

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading ( mV )	Uncertainty of pH measurement ( $\pm$ )	Coverage factor $k$
pH Electrode S/N.: 1453404	4.008	4.008	179.1	0.0046	2.00
	6.987	6.988	4.7	0.0084	2.00
	10.010	10.013	-172.4	0.0069	2.00

**Function : Temperature Measurement****( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLabExpert Pro-ISM

- Serial No. : 1453404

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point ( $^{\circ}\text{C}$ )	Standard Temperature ( $^{\circ}\text{C}$ )	UUC* Reading ( $^{\circ}\text{C}$ )	Error ( $^{\circ}\text{C}$ )	Uncertainty of measurement ( $\pm$ $^{\circ}\text{C}$ )	Coverage factor $k$
25.0	25.001	24.8	-0.201	0.13	2.00

**Remark : - UUC\* = Unit Under Calibration**

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

-o0o-

*Saithip*



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## Certificate of Calibration

Certificate No. : 23E753

Page : 1 of 2

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenCompact S220  
Serial No.: C104059460  
ID No.: RYG\_EN0183

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Condition As-Received: Used Item  
Received Date: 24 February 2023  
Calibration Date: 28 February 2023

Reference: 2302-0886DSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 10 ) %

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

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

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Multi-Product Calibrator	5500A	6440007	22E1670	18 May 2023

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Wutchareeporn Wongchutikrane  
Issue Date : 02 March 2023

Approved Signatory : \_\_\_\_\_

[ ] Phalinee Prabpaipal  
[x] Nuntawat Khamchai  
[ ] Pornthippa Tameyakul

B 0309672



Cert. No.: 23E753

Page.: 2 of 2

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

<b>Function:</b>	DC voltage measuremer	<b>Range:</b>	2000	mV	
	<u>Standard Value</u>	<u>UUC* Reading</u>	<u>Error</u>	<u>Uncertainty</u>	
	( mV )	( mV )	( mV )	( $\pm \mu V$ )	
	-200.0000	-200.0	0.0	72	
	-150.0000	-150.0	0.0	69	
	-100.0000	-100.0	0.0	65	
	-50.0000	-50.0	0.0	62	
	0.0000	0.0	0.0	58	
	50.0000	50.0	0.0	62	
	100.0000	99.9	-0.1	65	
	150.0000	149.9	-0.1	69	
	200.0000	199.9	-0.1	72	

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

**UUC\* = Unit Under Calibration.**

-o0o-



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T230116

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber ( Cooling Room )

Manufacturer : MODULAR

Model : IREVCOHCOO

Serial No. : C00351459

Customer Code : RYG\_EN0184

ID No. : T1939A5

Customer : ALS Laboratory Group (Thailand) Co.,Ltd. ( Rayong Branch)

616/10 Moo 5 T.Maenam Khu,

A.Pluakdaeng, Rayong 21140

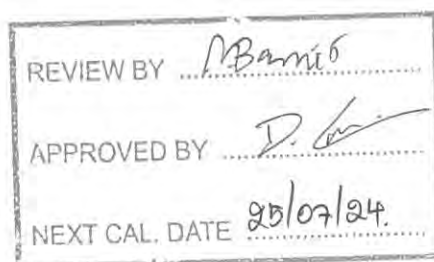
Customer Location : Laboratory

Date of Receipt : 23 January 2023

Calibrated By : Atiphong Rongrat ( Technician )

Approved By : Boonchai / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 07 FEB 2023



The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T230116

Page 2 of 4

## Calibration Report

**Equipment** : Chamber ( Cooling Room )  
**Date of Calibration** : 25 January 2023  
**Environment** : Temperature : 23.4-24.9 °C  
Line Voltage : 221.4-230.2 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 1 Hour - Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

5. Adjustment :

( X ) without adjustment

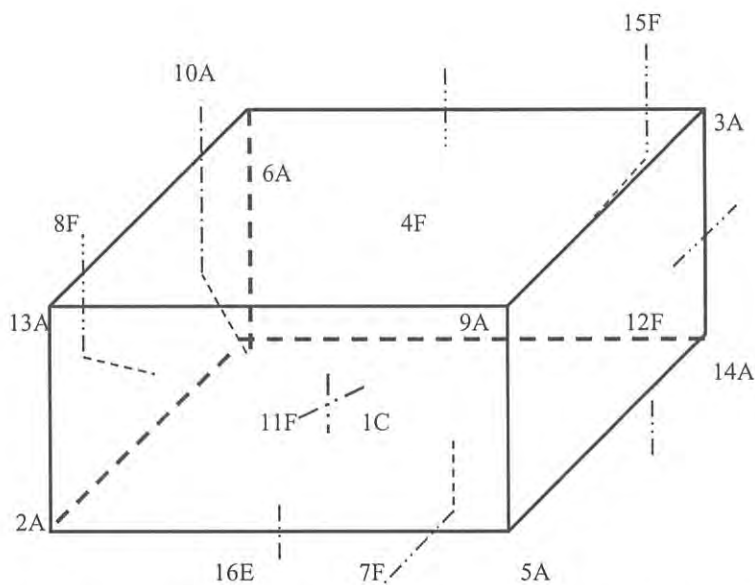
( ) after adjustment

Approved By. 

Certificate No. T230116

Page 3 of 4

## Calibration Report

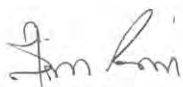


C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C	=	TN141
2A	=	TN142
3A	=	TN143
4F	=	TN144
5A	=	TN145
6A	=	TN146
7F	=	TN147
8F	=	TN148
9A	=	TN149
10A	=	TN150
11F	=	TN151

12F	=	TN152
13A	=	TN153
14A	=	TN154
15F	=	TN155
16E	=	TN156

Approved By. \_\_\_\_\_



Certificate No. T230116

Page 4 of 4

## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45	3.24	3.34
	TN153	TN154	TN155	TN156								
	3.28	3.22	3.28	3.21								

Chamber ( Cooling Room )			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (+°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor <i>k</i>
	Min , Max	Average				
3.0	2.8 , 4.1	3.5	1.20	1.20	1.90	2.07

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 



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Cert.No.: 22TW34

Page.: 1 of 2

## Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5000-115V
Serial No. :	15E102796
ID No. :	RYG_EN0032
Received Date :	11 February 2022
Test Date :	14 February 2022
Reference :	2202-0404DSC-4
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Laboratory Condition :	Temperature ( $25 \pm 5$ ) °C Humidity ( $50 \pm 20$ ) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean
Approved by :	 Approved Signatory
( ) Malee Butkruea	
( <input checked="" type="checkbox"/> ) Saithip Meangmai	
( ) Warakorn Lerngagtrakul	
Issue Date :	18 February 2022

REVIEW BY	<u>N. Bannit</u>
APPROVED BY	<u>D. [Signature]</u>
NEXT CAL. DATE	<u>15/8/23</u>



Cert.No.: 22TW34

Page.: 2 of 2

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

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

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

-o0o-

Saithip

a 1094744



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Cert. No.: 22LM12

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** DO Meter with Sensor

**Manufacturer :** YSI

**Model :** 5000-115V

**Serial No. :** 15E102796

**ID No. :** RYG\_EN0032

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

**Location :** TPA On Site Calibration Laboratory

**Received Order :** 11 February 2022

**Calibrated Date :** 21 February 2022

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**AC Line Voltage :** ( 220 ± 22 ) V

**Calibrated by :** Kunchit Promprat

**Approved by :** Malee Butkruea  
Approved Signatory

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

**Issue Date :** 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0038008



Equipment : DO Meter with Sensor

Condition As-Received : Used Item

Reference : 2202-0404DSC-5

Cert. No.: 22LM12

Page.: 2 of 2

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1523	2188080	2111273	22 Nov 2022

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

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function :** Temperature measurement.

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

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

**UUC\* :** Unit Under Calibration

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

-o0o-

*Mahu*



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Cert. No.: 22TM317

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Low Temp. Incubator

**Manufacturer :** Memmert

**Model :** IPP750

**Serial No. :** V818.0084

**ID No. :** RYG\_EN0154

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

**Location :** BOD Room

**Received Order :** 22 April 2022

**Calibration Date :** 22 April 2022

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Man Pattanapongpaiboon

REVIEW BY	<i>N. Banvit</i>
APPROVED BY	<i>D. [Signature]</i>
NEXT CAL. DATE	21/10/23

**Approved by :**

*Manu*  
\_\_\_\_\_  
Approved Signatory

- ( ) Pornthippa Tameyakul  
( / ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :**

3 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0040735



Equipment : Low Temp. Incubator

Condition As-Received : Used Item

Reference : 2204-0146OC-1

Cert. No.: 22TM317

Page.: 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

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

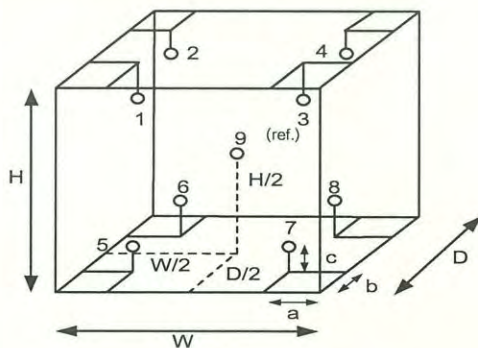
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



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

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.60 m  
W = 1.0 m  
H = 1.2 m  
Capacity = 0.75 m<sup>3</sup>

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

*Malu*



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2204-0146OC-1  
Result of Calibration :- ( \* ) Without Adjustment

Cert. No.: 22TM317

Page.: 3 of 3

Function of UUC\* : Temperature Source

Fresh air setting : Close

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

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

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

-o0o-

Malu



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## Certificate of Calibration

Certificate No. : 22T1592

Page : 1 of 2

Equipment : Digital Thermometer With Sensor

Manufacturer: Testo

Model : 106

Serial No.: 51366062/1220

ID No.: RYG\_FS0541

Condition As-Received: Used Item

Received Date: 26 August 2022

Calibration Date: 31 August 2022  
to 06 September 2022

Reference: 2208-0964DSC

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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Corporate Services 3: Equipment Calibration and Testing Services.

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

616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong  
21140, Thailand

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with  
Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Digital Thermometer	1529	A7A609	21I1126	14 Oct 2022
2) Industrial Platinum Resistance Thermometer	5627	824304	21I1126	14 Oct 2022

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

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

-National Institute of Metrology Thailand (NIMT)

REVIEW BY	Tanasit.
APPROVED BY	Supt S
NEXT CAL. DATE	31/08/23.

Calibrated by : Pitak Srimongkol  
Issue Date : 12 September 2022

Approved Signatory :

- [ ] Phalinee Prabpaipal  
[ ] Chatchawan Khunpiluek  
[x] Wanlop Larpkurn

B 0296666



Cert. No.: 22T1592

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement

Dimension of probe : Diameter 3 mm., Length 55 mm. Sheath material : Stainless Steel

<u>Immersion Depth</u> ( mm. )	<u>Standard Temperature</u> ( °C )	<u>UUC* Reading</u> ( °C )	<u>Error</u> ( °C )	<u>Uncertainty of Measurement</u> ( ±°C )
50	24.9996	25.0	0.0004	0.12
50	30.0027	30.0	-0.0027	0.12
50	40.0022	40.1	0.0978	0.12

**UUC\*** : Unit Under Calibration

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

-o0o-



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



## Certificate of Calibration

Certificate No. : 22T1601

Page : 1 of 2

Equipment : Digital Thermometer With Sensor

Manufacturer: Testo

Model : 106

Serial No.: 31282167/504

ID No.: RYG\_FS0468

Condition As-Received: Used Item

Received Date: 01 September 2022

Calibration Date: 07 September 2022  
to 08 September 2022

Reference: 2209-0057DSC

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

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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

616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong  
21140, Thailand

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with  
Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Black Stack Thermometer	1560	8C454	22I616	23 May 2023
2) PRT Scanner Module	2562	A01303	22I616	23 May 2023
3) Industrial Platinum Resistance Thermometer	5627-12	571971	22I616	23 May 2023

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

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

-National Institute of Metrology Thailand (NIMT)

REVIEW BY	Tanasit.
APPROVED BY	Supt S
NEXT CAL. DATE	09/09/23.

Calibrated by : Sataporn Mulkamdee  
Issue Date : 15 September 2022

Approved Signatory :

- [ ] Phalinee Prabpaipal  
[ ] Chatchawan Khunpiluek  
[x] Wanlop Larpkurn



Cert. No.: 22T1601

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement

Dimension of probe : Diameter 3 mm., Length 55 mm. Sheath material : Stainless Steel

<b>Immersion</b>	<b>Standard</b>	<b>UUC*</b>		<b>Uncertainty</b>
<b>Depth</b>	<b>Temperature</b>	<b>Reading</b>	<b>Error</b>	<b>of Measurement</b>
( mm. )	( °C )	( °C )	( °C )	( ±°C )
50	25.0049	24.9	-0.1049	0.12
50	30.0039	29.9	-0.1039	0.12
50	39.9989	39.9	-0.0989	0.12

**UUC\*** : Unit Under Calibration

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

-o0o-

# 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 *Shiruk 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

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)

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

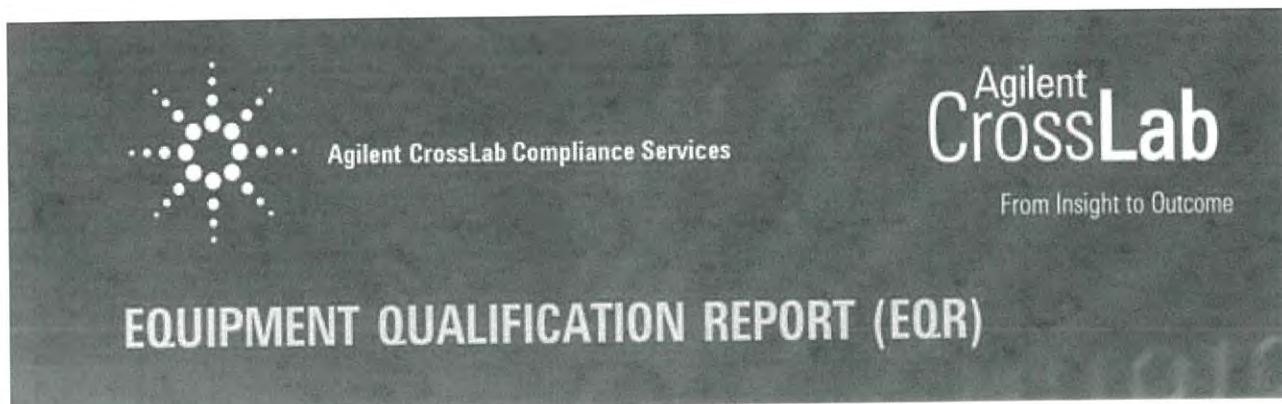
The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

\*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.  
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.

**Agilent CrossLab Compliance**

Qualification Type: ICPMS-OQ

System ID: JP12091612

EQP Name: AgilentRecommended

EQP Revision: ICPMS.02.50

EQP Publish Date: March 2020

Date: June 14, 2022 10:32:16 AM

Report Type: Report

Org. Name: ALS Laboratory Group (Thailand) Co.,Ltd.

Org. Location: 104 Phatthanakarn 40, Suan Luang, Bangkok 10250  
Thailand.REVIEW BY Tattaporn C.APPROVED BY Santana N.NEXT CAL. DATE 14/12/23

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## Test Summary

### Purpose

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

### Details

Test	Status	Runs
Autosampler Check : ASX-520	Pass	1
Integrated Sample Introduction System (ISIS) Check : ISIS2	Pass	1
Autotune : G3281A	Pass	1
Background (No Gas Mode) : G3281A	Pass	1
Background (Gas Modes) : G3281A	Pass	1
20-Minute Stability (No Gas Mode) : G3281A	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: 6005218484  
EQP Name: AgilentRecommended  
EQP Revision: ICPMS.02.50  
Report Type: Report

### Organization Details

Name: ALS Laboratory Group (Thailand) Co.,Ltd.  
Location: 104 Phatthanakarn 40, Suan Luang, Bangkok 10250 Thailand.

### Local Contact Details

Name: Khan Chatchanai  
Job Title: Lab Manager  
Qualification Location: Spectro Room

### Operator Details

Name: Panthep Kurasathain  
Job Title: Field Service Engineer

### Data Acquisition Details

Acquisition Software Name: MassHunter  
Acquisition Software Revision: D.01.01

Customer Data System (CDS): IcpMs: MassHunter

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### ICP-MS 1

Manufacturer	Agilent Technologies
Name	7700x
Model Number	G3281A
Detector Type	SQ
Nebulizer	Mira Mist (G3161)
Spray Chamber	Quartz
Torch	Quartz
Sampling Cone	Ni
Skimmer Cone	Ni
Serial Number	JP12091612
Firmware Revision	D.01.01

#### ISIS 1

Manufacturer	Agilent Technologies
Name	ISIS2
Model Number	G4911A
Installed Options	#003: 2 pumps, 1 valve, auto dilution and discrete sampling
Type	Peristaltic pump system

#### Autosampler 1

Manufacturer	Agilent Technologies
Name	ASX-520
Model Number	G3286A
Serial Number	031403A520

#### Chiller 1

Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G3292A
Serial Number	4N1220700

## Calculation Formulas

### Purpose

This section includes calculation formulas for all available tests. Depending upon which tests are scheduled, all or some apply to your qualification.

For a description of calculations for ICP-MS tests performed by the MassHunter software, refer to the MassHunter application and documentation.

## Protocol Details

### Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ICPMS.02.50	20-Minute Stability (No Gas Mode)
ICPMS.02.50	Autosampler Check
ICPMS.02.50	Autotune
ICPMS.02.50	Background (Gas Modes)
ICPMS.02.50	Background (No Gas Mode)
ICPMS.02.50	Integrated Sample Introduction System (ISIS) Check

# Autosampler Check

## Purpose

This test demonstrates that the autosampler module is correctly installed and connected. It does not test module performance.

---

## Setpoint

### Results

Criteria	Observed Result	Expected Result	Status
After the self test, is probe in the home position?	Yes	Yes	Pass
As commanded, is the probe positioned at vial 2?	Yes	Yes	Pass

Setpoint Status: Pass Runs: 1

### Overall Autosampler Check Test Status

Pass

---

# Integrated Sample Introduction System (ISIS) Check

Purpose

This test demonstrates that the ISIS module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
As commanded, does the pump rotate?	Yes	Yes	Pass
As commanded, do the valves load and inject?	Yes	Yes	Pass

Setpoint Status: Pass

Runs: 1

Overall Integrated Sample Introduction System (ISIS) Check Test Status

Pass

## Autotune

### Purpose

This test uses traceable checkout standards to run a software-executed autotune in all modes. The tune report provides values for peak width, mass axis, sensitivity, oxide species, and doubly-charged species tests.

---

### Setpoint

### Results

Peakwidth Mass 7

Agilent Recommended:

Status:

	0.735	AMU
>=	0.65	
<=	0.80	

Pass

Peakwidth Mass 89

Agilent Recommended:

Status:

	0.732	AMU
>=	0.65	
<=	0.80	

Pass

Peakwidth Mass 205

Agilent Recommended:

Status:

	0.746	AMU
>=	0.65	
<=	0.80	

Pass

Mass Axis 7

Agilent Recommended:

Status:

	7.00	AMU
>=	6.9	
<=	7.1	

Pass

Mass Axis 89

Agilent Recommended:

Status:

	89.00	AMU
>=	88.9	
<=	89.1	

Pass

Mass Axis 205

Agilent Recommended:

Status:

	205.00	AMU
>=	204.9	
<=	205.1	

Pass

Mass 7 Sensitivity No Gas

81.18

Mcps/ppm

Agilent Recommended:

&gt;= 25.5

Status:

Pass

Mass 89 Sensitivity No Gas

247.81

Mcps/ppm

Agilent Recommended:

&gt;= 85

Status:

Pass

Mass 205 Sensitivity No Gas

184.87

Mcps/ppm

Agilent Recommended:

&gt;= 51

Status:

Pass

Mass 59 Sensitivity He

84.86

Mcps/ppm

Agilent Recommended:

&gt;= 20.4

Status:

Pass

Oxide Ratio 156/140

1.119

%

Agilent Recommended:

&lt;= 1.38

Status:

Pass

Doubly Charged Species Ratio 70/140

1.140

%

Agilent Recommended:

&lt;= 2.3

Status:

Pass

Setpoint Status:

Pass

Runs: 1

Overall Autotune Test Status

Pass

## Background (No Gas Mode)

### Purpose

This test examines the background of the ICP-MS in no gas mode by monitoring ions during a blank run.

---

### Setpoint

#### Conditions

Masses:	7	AMU
	89	AMU
	205	AMU

#### Measurements and Results

Masses (AMU):	7	89	205	
Measured Value:	4.900	7.100	18.400	cps
Agilent Recommended:	<= 10	<= 10	<= 30	
Status:	Pass	Pass	Pass	

Setpoint Status: **Pass**

Runs: 1

#### Overall Background (No Gas Mode) Test Status

Pass

## Background (Gas Mode)

### Purpose

This test examines the background of the ICP-MS in the various gas modes by monitoring ions during a blank run.

Setpoint Gas Mode: Helium

### Conditions

Mass: 78 AMU  
Integration Time: 1.0 sec  
Cycles: 20

### Measurements and Results

Mass (AMU): 78  
Measured Value: 21.1000 cps  
Agilent Recommended: ≤ 460  
Status: Pass

Setpoint Status: Pass

Runs: 1

### Overall Background (Gas Mode) Test Status

Pass

## 20-Minute Stability (No Gas Mode)

### Purpose

This test monitors the abundance of ions present in the checkout standard over a 20-minute period to verify that the signal is stable. The %RSD of the abundance of given ions is calculated internally by the software and compared to the limit.

### Setpoint

#### Conditions

Mode:	Spectrum	
Masses:	7, 9, 59, 89, 140, 205	
Integration Time:	9.99	sec
Peak Pattern:	3	points/peak
Repetitions:	20	
Sweeps/Replicates:	100	

#### Measurements and Results

Masses (AMU):	7	89	205	
Stability RSD:	0.2	0.6	0.6	%
Agilent Recommended:	<= 3.45	<= 3.45	<= 3.45	
Status:	Pass	Pass	Pass	

Setpoint Status: Pass Runs: 1

#### Overall 20-Minute Stability (No Gas Mode) Test Status

Pass

## Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

## Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.

Location	Category	Document Name	Page
EQR	General	Certificate of System Qualification	17
EQR	General	Operator's training certificate and qualifications	18
EQR	General	Certificate of Qualification for ACE	19
EQR	General	Certificate of Qualification for ACE	20
EQR	General	Tune reports	21
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## General

Document Name: Certificate of System Qualification



## Agilent Compliance Engine Self Qualification

Date: September 14, 2021 4:59:15 PM

Drive Serial #: ACA025C9

Platform Revision:

ACE 3.11

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Dissolution	6	Conforms
Emission Spectroscopy	3	Conforms
Gas Chromatography - GCMS	17	Conforms
Gas Chromatography	29	Conforms
Gel Permeation Chromatography	9	Conforms
ICP-MS	6	Conforms
Infrared Spectroscopy	7	Conforms
Liquid Chromatography	17	Conforms
Liquid Chromatography - LCMS	8	Conforms
Microfluidics	18	Conforms
Sample Preparation - Gas Chromatography	9	Conforms
Sample Preparation - Liquid Chromatography	8	Conforms
Supercritical Fluid Chromatography	15	Conforms
Software	6	Conforms
UV-Vis Spectrophotometer	13	Conforms

## Overall Qualification Status

Conforms

## General

Document Name: Operator's training certificate and qualifications



## Certificate of Completion

Learner Name: Panthep Kurasathain

Title Of Course: AN-CE-ICPMS-2-017-B:7700x/7700s ICP-MS Intro. -Oper.H/W.S/W &amp; OQ/PV

Completion Date: November 22, 2012

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name:

Certificate of Qualification for ACE



## Certificate of Completion

Learner Name:	Panthep Kurasathain
Title Of Course:	AN-CE-SS-II-030-A: ACE 3.X User Update Training
Completion Date:	July 7, 2020
Certified By Company:	Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Certificate of Qualification for ACE



## Certificate of Completion

Learner Name: Panthep Kurasathain

Title Of Course: AN-CE-ICPMS-2-035-B: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-MS Systems

Completion Date: October 31, 2020

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

## General

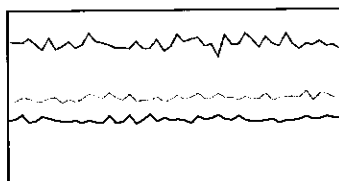
Document Name: Tune reports

## Tune Report

Operator Name Supakwan Mak  
 Acq/Data Batch C:\Agilent\ICPMH11\UserTune.b  
 Acq. Date-Time 6/14/2022 9:03:15 AM  
 Report Comment PMOQ 14 June 2022  
 Instrument Name G3281A JP12091612

## [No Gas]

## Sensitivity



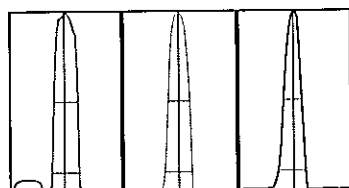
Mass	Range	Count	RSD%	Background
7	10000	8118	3.585	4.900
89	50000	24781	3.128	7.100
205	50000	18487	3.808	18.400

Sampling Period [sec] 0.311  
 Integration Time [sec] 0.1

## Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.119 %  
 Doubly Charged 70 / 140 1.140 %

## Resolution/Axis



Mass	Peak Height	Axis	W-50%	W-10%
7	8050.47	7.00	0.65	0.735
89	24725.81	89.00	0.57	0.732
205	18559.81	205.00	0.49	0.746

Integration Time [sec] 0.1  
 Acquisition Time [sec] 22.74  
 Y Axis Linear

## Tune Parameters

## Plasma Parameters

Plasma Mode	---	Nebulizer Gas	1.05 L/min	Makeup Gas	0.00 L/min
RF Power	1550 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.80 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	8.0 mm	S/C Temp	2 °C		

## Lens Parameters

Extract 1	0.0 V	Omega Lens	8.6 V	Deflect	12.0 V
Extract 2	-190.0 V	Cell Entrance	-30 V	Plate Bias	-40 V
Omega Bias	-90 V	Cell Exit	-50 V		

## Cell Parameters

Use Gas	No	3rd Gas Flow	---	Energy Discrimination	5.0 V
He Flow	0.0 mL/min	OctP Bias	-8.0 V		

Document Name: Tune reports

## Tune Report

H2 Flow — OctP RF 200 V

**QP Parameters**

Mass Gain	152	Axis Gain	1.0032	QP Bias	-3.0 V
Mass Offset	123	Axis Offset	0.12		

**Hardware Settings**

**Torch**

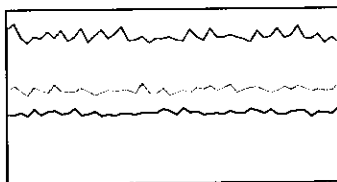
Torch H	-0.4 mm	Torch V	0.0 mm
---------	---------	---------	--------

**EM**

Discriminator	4.5 mV	Analog HV	1708 V	Pulse HV	1356 V
---------------	--------	-----------	--------	----------	--------

[He]

## Sensitivity



Mass	Range	Count	RSD%	Background
59	10000	8486	3.392	15,700
89	20000	10724	3.135	13,900
205	50000	20200	3.166	22,100

Sampling Period [sec] 0.31  
Integration Time [sec] 0.1

## Oxide/Doubly Charged Ratio

Oxide 156 / 140 1.122 %  
Doubly Charged 70 / 140 1.288 %

## Tune Parameters

## Plasma Parameters

Plasma Mode	—	Nebulizer Gas	1.05 L/min	Makeup Gas	0.00 L/min
RF Power	1550 W	Option Gas	---	Auxiliary Gas	0.90 L/min
RF Matching	1.80 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	8.0 mm	S/C Temp	2 °C		

## Lens Parameters

Extract 1	0.0 V	Omega Lens	7.4 V	Deflect	3.6 V
Extract 2	-200.0 V	Cell Entrance	-90 V	Plate Bias	-115 V
Omega Bias	-90 V	Cell Exit	-70 V		

## Cell Parameters

Use Gas	Yes	3rd Gas Flow	—	Energy Discrimination	3.0 V
He Flow	4.5 mL/min	OctP Bias	-21.0 V		
H2 Flow	—	OctP RF	190 V		

## QP Parameters

Mass Gain	152	Axis Gain	1.0032	QP Bias	-18.0 V
Mass Offset	123	Axis Offset	0.12		

## Hardware Settings

**Torch**

Torch H	-0.4 mm	Torch V	0.0 mm
---------	---------	---------	--------

2 of 3

6/14/2022 9:03 AM

Date: June 14, 2022 10:32:16 AM  
System ID: JP12091612

Document Name: Tune reports

## Tune Report

### EM

Discriminator

4.5 mV

Analog HV

1708 V

Pulse HV

1356 V

3 of 3

6/14/2022 9:03 AM

Date: June 14, 2022 10:32:16 AM  
System ID: JP12091612

General

Document Name: Test Report

Batch Summary Report							
Batch Folder:		D:\Agilent Service\PMOQ 13-6-22\BG He.b\					
Analysis File:		BG He.batch.bin					
Tune Step:		#1 He					
	Rjct	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		6/14/2022 10:03:39 AM	001SMPL.d	BG He	Sample		1.0000
Page 1 / 2				6/14/2022 10:09:04 AM			

Document Name: Test Report

## Batch Summary Report

Analyte Table

		78 (He1)	
Sample Name		CPS	CPS RSD
1	BG He	21.1000	38.0

Page 2 / 2

6/14/2022 10:09:04 AM

Date: June 14, 2022 10:32:16 AM  
System ID: JP12091612

## General

Document Name: Test Report

## Batch Summary Report

Batch Folder: D:\Agilent Service\PMOQ 13-6-22\ OQ 20 Min.b\  
Analysis File: OQ 20 Min.batch.bin  
Tune Step: #1 No Gas

	Ret	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		6/14/2022 9:29:27 AM	001SMPL.d	20 min	Sample		1.0000

Document Name:

Test Report

## Batch Summary Report

Analyte Table

		7 [No Gas]		9 [No Gas]		59 [No Gas]		89 [No Gas]	
Sample Name		CPS	CPS RSD	CPS	CPS RSD	CPS	CPS RSD	CPS	CPS RSD
1	20 min	82477.8975	0.2	285.3875	5.8	162011.0035	0.7	241211.0790	0.6

		140 [No Gas]		205 [No Gas]	
Sample Name		CPS	CPS RSD	CPS	CPS RSD
1	20 min	252452.6980	0.7	181154.8205	0.6

## 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.)

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---

Date:	June 14, 2022 10:32:16 AM
System ID:	JP12091612

User Name: panthep\_kurasathain  
 Hostname: ASBKKWX313

System Id: JP12091612  
 Print Date: June 14, 2022 10:32:20 AM

ALS OQHW 7700 14Jun2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 14, 2022 10:14:43 AM	Audit	SessionCreated	Session	None
June 14, 2022 10:14:43 AM	Start	Configuration	Session	None
June 14, 2022 10:14:43 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
June 14, 2022 10:19:18 AM	Audit	EqpLoaded	Session	EQP details for primary technique [lcpMs] - File path: [Protocol]Packs/lcpMs/Configurations/02.50/lcpMs.02.50.eqp], EQP File Name: [lcpMs.02.50.eqp], EQP Name: [AgilentRecommended]
June 14, 2022 10:19:20 AM	End	Configuration	Session	None
June 14, 2022 10:19:24 AM	Start	Qualification	Session	OQ
June 14, 2022 10:19:24 AM	Start	Execution	Autosampler Check : ASX-520: Autosampler Check	None
June 14, 2022 10:19:42 AM	End	Execution	Autosampler Check : ASX-520: Autosampler Check	Run Count : 1
June 14, 2022 10:19:43 AM	Start	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2: Integrated Sample Introduction System (ISIS) Check	None
June 14, 2022 10:19:47 AM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2: Integrated Sample Introduction System (ISIS) Check	Run Count : 1
June 14, 2022 10:19:50 AM	Start	Execution	Autotune : G3281A: Autotune 1	None
June 14, 2022 10:22:22 AM	End	Execution	Autotune : G3281A: Autotune 1	Run Count : 1

User Name: panthep\_kurasathain  
 Hostname: ASBKKWX313

System Id: JP12091612  
 Print Date: June 14, 2022 10:32:20 AM

## ALS OQHW 7700 14Jun2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 14, 2022 10:22:24 AM	Start	Execution	Background (No Gas Mode) : G3281A: No Gas Mode Background 1	None
June 14, 2022 10:22:48 AM	End	Execution	Background (No Gas Mode) : G3281A: No Gas Mode Background 1	Run Count : 1
June 14, 2022 10:22:49 AM	Start	Execution	Background (Gas Modes) : G3281A: Gas Mode Background :Helium	None
June 14, 2022 10:23:35 AM	End	Execution	Background (Gas Modes) : G3281A: Gas Mode Background :Helium	Run Count : 1
June 14, 2022 10:23:37 AM	Start	Execution	20-Minute Stability (No Gas Mode) : G3281A: 20-Minute Stability (No Gas Mode) 1	None
June 14, 2022 10:24:06 AM	End	Execution	20-Minute Stability (No Gas Mode) : G3281A: 20-Minute Stability (No Gas Mode) 1	Run Count : 1
June 14, 2022 10:24:08 AM	End	Qualification	Session	OQ
June 14, 2022 10:24:08 AM	Start	Reporting	Session	None
June 14, 2022 10:30:26 AM	Audit	Reporting	Session	Report Generated : Certificate
June 14, 2022 10:30:39 AM	Audit	Reporting	Session	Report Generated : Report

# Certificate of System Qualification

ICPMS-OQ

System ID: JP12091612  
Organization Name: ALS Laboratory Group (Thailand) Co.,Ltd.  
Organization Location: 104 Phatthanakarn 40, Suan Luang, Bangkok 10250 Thailand.

Date: June 14, 2022 10:32:51 AM  
EQP Name: AgilentRecommended  
EQP Revision: ICPMS.02.50  
Overall Qualification Status: Pass

## Autosampler Check

### Overall Autosampler Check Test Status

Pass

## Integrated Sample Introduction System (ISIS) Check

### Overall Integrated Sample Introduction System (ISIS) Check Test Status

Pass

## Autotune

Peakwidth Mass 7	Pass
Peakwidth Mass 89	Pass
Peakwidth Mass 205	Pass
Mass Axis 7	Pass
Mass Axis 89	Pass
Mass Axis 205	Pass
Mass 7 Sensitivity No Gas	Pass
Mass 89 Sensitivity No Gas	Pass
Mass 205 Sensitivity No Gas	Pass
Mass 59 Sensitivity He	Pass
Oxide Ratio 156/140	Pass
Doubly Charged Species Ratio 70/140	Pass

### Overall Autotune Test Status

Pass

Date: June 14, 2022 10:32:51 AM  
System ID: JP12091612

## Background (No Gas Mode)

Setpoint Status: Pass

Masses (AMU):	7	89	205	
Measured Value:	4.900	7.100	18.400	cps
Agilent Recommended:	<= 10	<= 10	<= 30	
Status:	Pass	Pass	Pass	

## Overall Background (No Gas Mode) Test Status

Pass

## Background (Gas Mode)

Gas Mode: Helium

Setpoint Status: Pass

Mass (AMU):	78	
Measured Value:	21.1000	cps
Agilent Recommended:	<= 460	
Status:	Pass	

## Overall Background (Gas Mode) Test Status

Pass

## 20-Minute Stability (No Gas Mode)

Masses (AMU):	7	89	205	
Stability RSD:	0.2	0.6	0.6	%
Agilent Recommended:	<= 3.45	<= 3.45	<= 3.45	
Status:	Pass	Pass	Pass	

## Overall 20-Minute Stability (No Gas Mode) Test Status

Pass

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### ICP-MS 1

Manufacturer	Agilent Technologies
Name	7700x
Model Number	G3281A
Detector Type	SQ
Nebulizer	Mira Mist (G3161)
Spray Chamber	Quartz
Torch	Quartz
Sampling Cone	Ni
Skimmer Cone	Ni
Serial Number	JP12091612
Firmware Revision	D.01.01

#### ISIS 1

Manufacturer	Agilent Technologies
Name	ISIS2
Model Number	G4911A
Installed Options	#003: 2 pumps, 1 valve, auto dilution and discrete sampling
Type	Peristaltic pump system

#### Autosampler 1

Manufacturer	Agilent Technologies
Name	ASX-520
Model Number	G3286A
Serial Number	031403A520

#### Chiller 1

Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G3292A
Serial Number	4N1220700

## Electronic Signature

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Logged On User Name:	panthep_kurasathain@agilent.com
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Reason for Signature:	Executed protocol and published this original version of document

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User Name: panthep\_kurasathain  
 Hostname: ASBKKWX313

System Id: JP12091612  
 Print Date: June 14, 2022 10:32:52 AM

ALS OQHW 7700 14Jun2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 14, 2022 10:14:43 AM	Audit	SessionCreated	Session	None
June 14, 2022 10:14:43 AM	Start	Configuration	Session	None
June 14, 2022 10:14:43 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
June 14, 2022 10:19:18 AM	Audit	EqpLoaded	Session	EQP details for primary technique [lcpMs] - File path: [ProtocolPacks/lcpMs/Configurations/02.50/lcpMs.02.50.eqp], EQP File Name: [lcpMs.02.50.eqp], EQP Name: [AgilentRecommended]
June 14, 2022 10:19:20 AM	End	Configuration	Session	None
June 14, 2022 10:19:24 AM	Start	Qualification	Session	OO
June 14, 2022 10:19:24 AM	Start	Execution	Autosampler Check : ASX-520: Autosampler Check	None
June 14, 2022 10:19:42 AM	End	Execution	Autosampler Check : ASX-520: Autosampler Check	Run Count : 1
June 14, 2022 10:19:43 AM	Start	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2: Integrated Sample Introduction System (ISIS) Check	None
June 14, 2022 10:19:47 AM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2: Integrated Sample Introduction System (ISIS) Check	Run Count : 1
June 14, 2022 10:19:50 AM	Start	Execution	Autotune : G3281A: Autotune 1	None
June 14, 2022 10:22:22 AM	End	Execution	Autotune : G3281A: Autotune 1	Run Count : 1

Page 1 / 3

User Name: panthep\_kurasathaln  
 Hostname: ASBKKWX313

System Id: JP12091612  
 Print Date: June 14, 2022 10:32:52 AM

ALS OQHW 7700 14Jun2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 14, 2022 10:22:24 AM	Start	Execution	Background (No Gas Mode) : G3281A: No Gas Mode Background 1	None
June 14, 2022 10:22:48 AM	End	Execution	Background (No Gas Mode) : G3281A: No Gas Mode Background 1	Run Count : 1
June 14, 2022 10:22:49 AM	Start	Execution	Background (Gas Modes) : G3281A: Gas Mode Background :Helium	None
June 14, 2022 10:23:35 AM	End	Execution	Background (Gas Modes) : G3281A: Gas Mode Background :Helium	Run Count : 1
June 14, 2022 10:23:37 AM	Start	Execution	20-Minute Stability (No Gas Mode) : G3281A: 20-Minute Stability (No Gas Mode) 1	None
June 14, 2022 10:24:06 AM	End	Execution	20-Minute Stability (No Gas Mode) : G3281A: 20-Minute Stability (No Gas Mode) 1	Run Count : 1
June 14, 2022 10:24:08 AM	End	Qualification	Session	OQ
June 14, 2022 10:24:08 AM	Start	Reporting	Session	None
June 14, 2022 10:30:26 AM	Audit	Reporting	Session	Report Generated : Certificate
June 14, 2022 10:30:39 AM	Audit	Reporting	Session	Report Generated : Report

User Name: panthep\_kurasathain  
Hostname: ASBKKWX313

System Id: JP12091612  
Print Date: June 14, 2022 10:32:52 AM

ALS OQHW 7700 14Jun2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 14, 2022 10:32:26 AM	Audit	Reporting	Session	Report Signed : Report PDF Name: ALS OQHW 7700 14Jun2022_20220614_OQ Report_1.pdf User Name: panthep_kurasathain@agilen t.com Full Name of Signer: Panthep Kuresathain Reason for signature: Executed protocol and published this original version of document

Certificate No. T220730

Page 1 of 6

## Certificate of Calibration

Equipment : HEATING BLOCK

Manufacturer : Environmental Express

Model : SC 196

Serial No. : 6974CECW3285

Customer Code : BKK\_EL0054


ID No. : T5306A3

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

Customer Location : Acid Digestion Lab

Date of Receipt : 30 March 2022

Calibrated By : Watcharapon Sangtong (Technician )

Approved By :  / Sujjar Naknakred ( Site Calibration Manager )

Date of Issue : 12 APR 2022

REVIEW BY	<u>Tattaporn C.</u>
APPROVED BY	<u>Sangtong N.</u>
NEXT CAL. DATE	<u>7/10/23</u>

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T220730

Page 2 of 6

## Calibration Report

**Equipment** : HEATING BLOCK  
**Date of Calibration** : 7 April 2022  
**Environment** : Temperature : 21.8-23.1 °C  
Line Voltage : 221.6-226.3 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T210008	08 June 2022
TC	TYPE T	TN231-TN240	T210008	08 June 2022
DATA LOGGER	34970A	T149	T210008	08 June 2022

3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good


Equipment Description :

Time Constant 2 Hour 25 Minute At 95 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

5. Adjustment :

( ) without adjustment

( X ) after adjustment

Approved By. 



# Metrological Center

## SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

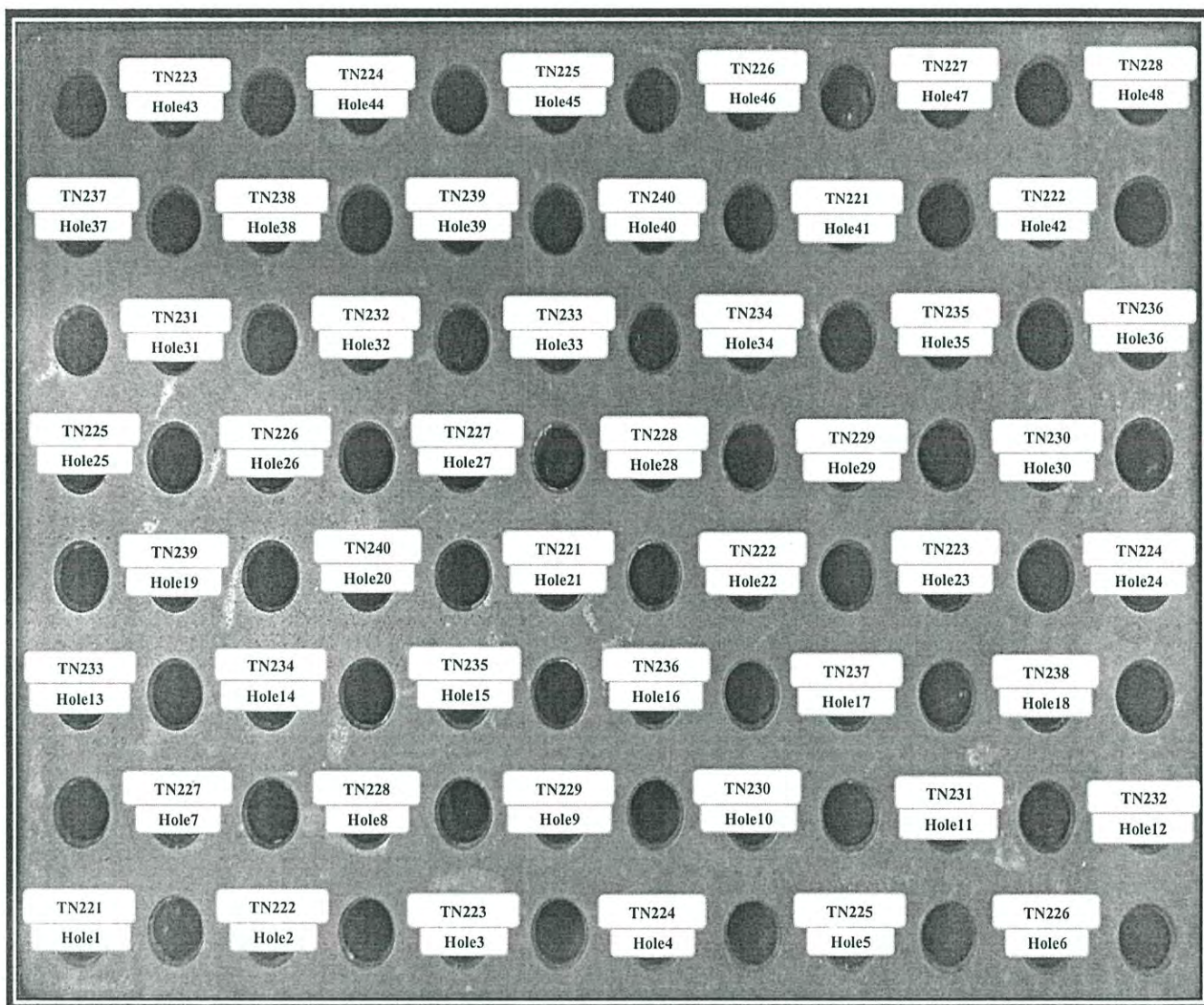
Website : [www.scieco.co.th](http://www.scieco.co.th)

E-Mail : [calibrate@scg.co.th](mailto:calibrate@scg.co.th)

Certificate No. T220730

Page 3 of 6

## Calibration Report



FRONT CONTROL

Approved By. \_\_\_\_\_

## Calibration Report

### Measurement Results

Calibration Point		Average Standard Reading at each position ( ° C )					
<b>R1 Hole1-Hole6</b>		<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>
CAL POINT	Max	93.60	93.82	94.05	94.20	94.36	94.26
95	Min	93.07	93.26	93.51	93.66	93.82	93.71
	Average	93.33	93.54	93.78	93.93	94.09	93.98
<b>R2 Hole7-Hole12</b>		<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>	<b>TN231</b>	<b>TN232</b>
	Max	94.59	94.79	94.63	94.55	94.82	95.00
	Min	94.05	94.25	94.08	93.97	94.26	94.44
	Average	94.32	94.52	94.36	94.26	94.54	94.72
<b>R3 Hole13-Hole18</b>		<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>	<b>TN237</b>	<b>TN238</b>
	Max	95.03	94.54	94.78	94.84	95.06	94.73
	Min	94.46	93.98	94.20	94.28	94.49	94.18
	Average	94.74	94.26	94.49	94.56	94.78	94.45
<b>R4 Hole19-Hole24</b>		<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>
	Max	94.89	94.82	95.73	95.85	95.73	96.10
	Min	94.33	94.26	95.51	95.62	95.51	95.85
	Average	94.61	94.54	95.62	95.73	95.62	95.97
<b>R5 Hole25-Hole30</b>		<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>
	Max	96.28	96.39	96.37	96.54	96.19	96.04
	Min	96.01	96.10	96.02	96.20	95.89	95.71
	Average	96.15	96.24	96.20	96.37	96.04	95.88
<b>R6 Hole31-Hole36</b>		<b>TN231</b>	<b>TN232</b>	<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>
	Max	96.84	96.97	97.03	96.48	96.33	95.76
	Min	96.53	96.65	96.71	96.08	95.98	95.43
	Average	96.68	96.81	96.87	96.28	96.16	95.60
<b>R7 Hole37-Hole42</b>		<b>TN237</b>	<b>TN238</b>	<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>
	Max	96.46	96.15	96.19	96.06	96.95	97.09
	Min	96.13	95.84	95.85	95.72	96.64	96.78
	Average	96.30	95.99	96.02	95.89	96.80	96.93
<b>R8 Hole43-Hole48</b>		<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>
	Max	96.91	96.58	96.13	96.19	96.34	96.19
	Min	96.55	96.21	95.80	95.87	96.03	95.88
	Average	96.73	96.40	95.96	96.03	96.18	96.03

Approved By. \_\_\_\_\_



## Calibration Report

### Measurement Results

Calibration Point		Average Standard Reading at each position ( ° C )					
<b>R1 Hole1-Hole6</b>		<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>
CAL POINT	Max	104.47	104.65	104.79	105.31	105.47	105.46
105	Min	104.15	104.27	104.45	104.98	105.14	105.20
	Average	104.31	104.46	104.62	105.15	105.31	105.33
<b>R2 Hole7-Hole12</b>		<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>	<b>TN231</b>	<b>TN232</b>
	Max	105.55	105.73	105.65	105.84	105.97	106.07
	Min	105.28	105.43	105.35	105.52	105.68	105.83
	Average	105.42	105.58	105.50	105.68	105.82	105.95
<b>R3 Hole13-Hole18</b>		<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>	<b>TN237</b>	<b>TN238</b>
	Max	106.14	106.06	105.81	106.05	105.81	105.87
	Min	105.85	105.81	105.55	105.80	105.53	105.64
	Average	106.00	105.94	105.68	105.92	105.67	105.75
<b>R4 Hole19-Hole24</b>		<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>	<b>TN223</b>	<b>TN224</b>
	Max	105.86	105.60	104.44	104.51	104.28	104.78
	Min	105.61	105.37	104.27	104.35	104.12	104.61
	Average	105.74	105.48	104.35	104.43	104.20	104.69
<b>R5 Hole25-Hole30</b>		<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>	<b>TN229</b>	<b>TN230</b>
	Max	104.94	104.93	104.97	105.08	104.68	104.69
	Min	104.77	104.75	104.76	104.90	104.51	104.49
	Average	104.85	104.84	104.86	104.99	104.60	104.59
<b>R6 Hole31-Hole36</b>		<b>TN231</b>	<b>TN232</b>	<b>TN233</b>	<b>TN234</b>	<b>TN235</b>	<b>TN236</b>
	Max	105.44	105.45	105.61	104.95	104.84	104.42
	Min	105.27	105.27	105.44	104.76	104.66	104.25
	Average	105.36	105.36	105.53	104.86	104.75	104.33
<b>R7 Hole37-Hole42</b>		<b>TN237</b>	<b>TN238</b>	<b>TN239</b>	<b>TN240</b>	<b>TN221</b>	<b>TN222</b>
	Max	105.17	104.70	104.59	104.51	105.22	105.53
	Min	105.00	104.53	104.41	104.35	105.04	105.37
	Average	105.08	104.62	104.50	104.43	105.13	105.45
<b>R8 Hole43-Hole48</b>		<b>TN223</b>	<b>TN224</b>	<b>TN225</b>	<b>TN226</b>	<b>TN227</b>	<b>TN228</b>
	Max	105.61	105.45	105.10	104.77	104.87	105.02
	Min	105.44	105.28	104.92	104.60	104.70	104.85
	Average	105.53	105.37	105.01	104.69	104.79	104.93

Approved By. \_\_\_\_\_



Certificate No. T220730

Page 5 of 6

## Calibration Report

### Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability ( $\pm$ °C)	Uncertainty ( $\pm$ °C)
	Min , Max	Average		
100.0	100.0 , 100.4	100.1	0.29	0.83
105.0	105.0 , 105.4	105.1	0.20	0.79

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k$  which for a t-distribution, providing a level of confidence of approximately 95 % .

 Approved By. 



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th



Certificate No. T221644

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber ( Cold Room )

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK\_EN0167

ID No. : T2463A3

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250


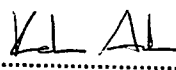
Customer Location : Environmental Laboratory

Date of Receipt : 27 June 2022

Calibrated By : Sujjar Naknakred ( Site Calibration Manager )

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 04 JUL 2022

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	30/12/23

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T221644

Page 2 of 4

## Calibration Report

**Equipment** : Chamber ( Cold Room )  
**Date of Calibration** : 30 June - 1 July 2022  
**Environment** : Temperature : 18.9-23.7 °C  
Line Voltage : 222.9-226.5 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).  
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	30 July 2022
TC	TYPE T	TN171-TN180	T210009	30 July 2022
DATA LOGGER	34970A	T149	T210009	30 July 2022

3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 3 Hour - Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

5. Adjustment :

( ) without adjustment

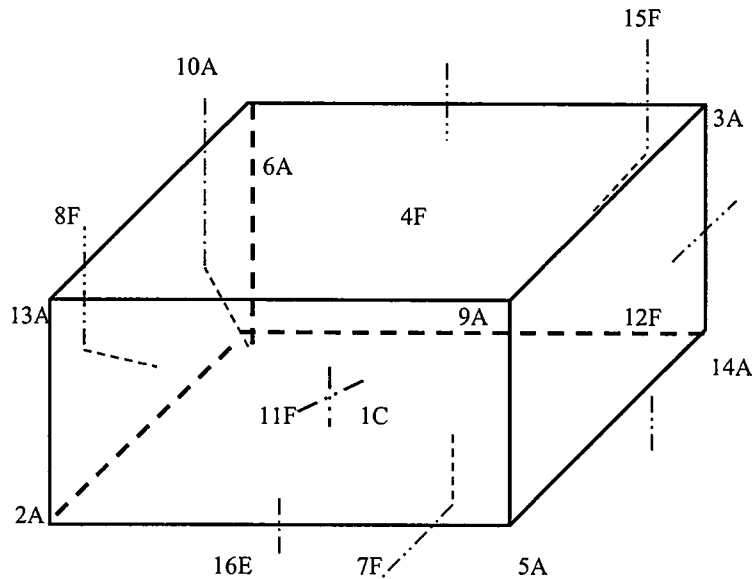
( X ) after adjustment

Approved By. 

Certificate No. T221644

Page 3 of 4

## Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C	=	TN161
2A	=	TN162
3A	=	TN163
4F	=	TN164
5A	=	TN165
6A	=	TN166
7F	=	TN167
8F	=	TN168
9A	=	TN169
10A	=	TN170

11F	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15F	=	TN175
16E	=	TN176

Approved By. 

Certificate No. T221644

Page 4 of 4

## Calibration Report

**Measurement Results:**

Average Standard Reading at each position (°C)										
Calibration Point	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.71	2.82	2.75	2.89	2.95	3.68	3.02	2.96	3.03	2.85
	TN171	TN172	TN173	TN174	TN175	TN176				
	2.97	3.02	2.89	3.04	2.97	3.33				

Chamber ( Cold Room )			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage
	Min , Max	Average					Factor <i>k</i>
3.0	2.9 , 4.0	3.2	2.99	1.05	1.30	1.66	2.00

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 



**Scientist  
Instrument**

REVIEW BY *P. Swinyaring*  
APPROVED BY *Santana N.*  
NEXT CAL. DATE *30/11/23*

## Performance Verification Certificate

**for Mercury Analyzer**

**Product ID** *Quicktrace M-8000 , Teledyne Leeman Labs*

**Equipment ID** *BKK\_EL0128 Mercury Analyzer*  
*S/N: US22133002*

*BKK\_EL0129 Autosampler*  
*S/N: 052222A560*

**Customer Name** *ALS Laboratory Group (Thailand) Co., Ltd.*  
**Address** *104 Soi Pattana 40, Pattana Rd. Suan Luang, Suan Luang*  
*Bangkok 10250 Thailand*

**Date of Qualified** *November 30, 2022*  
**Next Due date** *November 30, 2023*

This certifies for products which was performed in acceptable criteria specifications

<b>Autosampler &amp; Sample Introduction</b>	<b>PASSED</b>
<b>Analyzer</b>	<b>PASSED</b>
<b>Gas Liquid Separator &amp; Dryer</b>	<b>PASSED</b>
<b>CVFS Detector</b>	<b>PASSED</b>
<b>Electronics/Mechanical</b>	<b>PASSED</b>
<b>Data station/PC</b>	<b>PASSED</b>
<b>Analytical test</b>	<b>PASSED</b>

**Provided by**

**Scientist Instrument Co.,Ltd.**  
113 Soi Ekachai 44, Ekachai Road  
Khlong Bang Phran, Bangbon  
Bangkok 10150 Thailand

**Certified by** *Thunraphol Sakdayos*

**Thunraphol Sakdayos**  
**Service Engineer**



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM101

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Autoclave  
**Manufacturer :** Sanyo  
**Model :** MLS-3781  
**Serial No. :** 830167  
**ID No. :** BKK\_ML0037  
**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
**Location :** Media Preparation Room  
**Received Order :** 21 January 2022  
**Calibration Date :** 21 January 2022  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %  
**Calibrated by :** Krisda Malee

REVIEW BY	Sithichok T.
APPROVED BY	[Signature]
NEXT CAL. DATE	22/07/23

**Approved by :**

*Malee*

Approved Signatory

- ( ☒ ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ☐ ) Suwit Imjai

**Issue Date :**

3 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0037379



Equipment : Autoclave  
 Condition As-Received : Used Item  
 Reference : 2201-0616OC-3

Cert. No.: 22TM101

Page.: 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1 ) Data Acquisition	34972A	MY57013711	21LM7	16 Jun 2022

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

3. This certification is traceable to the International System of Unit.

4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3\*\*

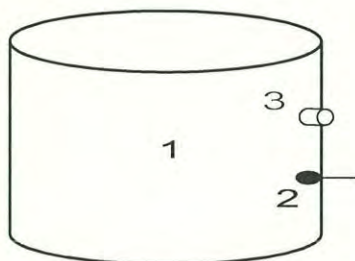
(\*\* = Categorization of pathogens according to hazard and categories of containment, second edition, 1990 )

It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source



	<b>Environmental</b>		
	( °C )	( %R.H. )	( Volt )
<b>Beginning of Calibration</b>	27	57	220
<b>Finished of Calibration</b>	26	59	221

<u>Position</u>	<u>Description</u>	<u>Ref. Std. ID No.:</u>
1 =	Center of chamber	18-18TC-01
2 =	Temperature sensor	18-18TC-02
3 =	Exhaust port	18-18TC-03

*Malu*



Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2201-0616OC-3

Cert. No.: 22TM101

Page.: 3 of 3

**Result of Calibration :-** ( \* ) Without Adjustment

Operating parameter Set : Temperature = 108 °C

Sterilization period = 15 minute

UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
108	108	1	108.044	0.29	0.040	0.94	2
		2	108.133				
		3	108.142				

Operating parameter Set : Temperature = 121 °C

Sterilization period = 15 minute

UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
121	121	1	121.082	0.21	0.11	0.91	2
		2	121.068				
		3	121.128				

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

**Stability** : One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\*** : Unit Under Calibration

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

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

-o0o-

*Malu.*



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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Cert. No.: 22TM102

Page.: 1 of 3

## Certificate of Calibration

Equipment : Incubator  
Manufacturer : SHEL-LAB  
Model : 1915A  
Serial No. : 0200599  
ID No. : BKK\_ML0010  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
Location : Incubation & Micrological Reading  
Received Order : 21 January 2022  
Calibration Date : 21 January 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Krisda Malee

REVIEW BY	Sithichok T.
APPROVED BY	[Signature]
NEXT CAL. DATE	22/07/23

Approved by :

Malee  
Approved Signatory

- ( ☒ ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ☐ ) Suwit Imjai

Issue Date :

3 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0037377



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2201-0616OC-1

Cert. No.: 22TM102

Page.: 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY57013711	21LM7	16 Jun 2022

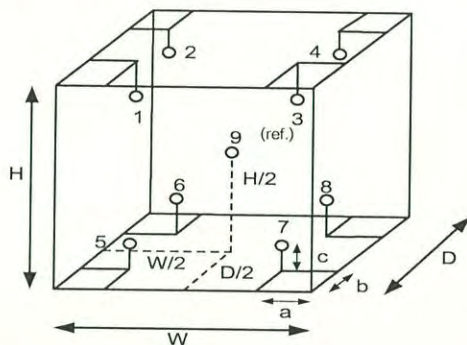
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	26	25
REL.Humid. ( % )	53	54
AC Supply ( Volt )	220	221

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-06
7	18-18RTD-07
8	18-18RTD-08
9 (ref.)	18-18RTD-09

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.90 m  
W = 0.75 m  
H = 1.2 m  
Capacity = 0.81 m<sup>3</sup>

Maku .



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2201-0616OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM102

Page.: 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
35.0	35.0	35.0	0.043	0.41	0.42	0.30	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
35.0	34.801	34.868	34.862	35.012	35.040	35.010	35.084	35.040	35.178

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

-o0o-

*Mahu.*



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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Cert. No.: 22TM1571

Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Binder

Model : ED 240/E2

Serial No. : 00-15533

ID No. : BKK\_ML0013

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

Location : Media Preparation Room

Received Order : 21 November 2022

Calibration Date : 21 November 2022

Ambient Temperature : (  $26 \pm 10$  ) °C

Relative Humidity : (  $50 \pm 30$  ) %

Calibrated by : Krisda Malee

Approved by :

*Malee*

Approved Signatory

( ) Pornthippa Tameyakul

(✓) Malee Butkruea

( ) Suwit Imjai

Issue Date : 29 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0048150



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2211-0623OC-1

Cert. No.: 22TM1571

Page : 2 of 3

**Procedure Used :-**

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44067817	22LM121	22 Aug 2023

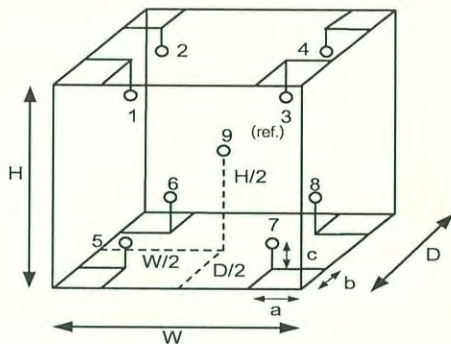
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) After Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	26	26
REL.Humid. ( % )	53	55
AC Supply ( Volt )	219	220

Position :	Ref. Std. ID No.:
1	21-15TC-01
2	21-15TC-02
3	21-15TC-03
4	21-15TC-04
5	21-15TC-05
6	21-15TC-06
7	21-15TC-07
8	21-15TC-08
9 (ref.)	21-15TC-09

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.50 m  
 W = 0.80 m  
 H = 0.60 m  
 Capacity = 0.24 m<sup>3</sup>

*Malu.*



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2211-0623OC-1  
Result of Calibration :- ( \* ) After Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 22TM1571

Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
180	180	180	0.70	1.5	2.9	1.4	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
180	179.520	180.585	178.855	179.482	178.827	179.938	179.074	180.199	180.068

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

-o0o-

*Malu*



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM677

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Water Bath  
**Manufacturer :** Memmert  
**Model :** WNE 45  
**Serial No. :** L712.0429  
**ID No. :** BKK\_ML0056  
**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang ,  
Bangkok 10250 Thailand  
**Location :** Incubator & Microbiological Reading  
**Received Order :** 20 May 2022  
**Calibration Date :** 20 May 2022  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Preecha Hlahib

**Approved by :**

  
Approved Signatory

- ( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ☒ ) Suwit Imjai

**Issue Date :** 24 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0041433



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2205-0404OC-1

Cert. No.: 22TM677

Page.: 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

**Instrument**

**Model**

**Serial No.**

**Cert. No.**

**Due Date**

1 ) Data Acquisition

34972A

MY57013823

22LM24

26 Feb 2023

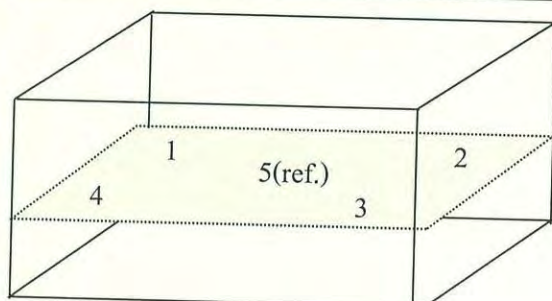
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

	Environmental		AC Voltage Supply ( Volt )
	( °C )	( %R.H. )	
Beginning of Calibration	24	47	220
Finished of Calibration	24	52	221



Front

Position :	Ref. Std. S/N.:
1	4804539-006
2	4804539-007
3	4804539-008
4	4804539-009
5(ref.)	4804539-010

*Signature*



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2205-0404OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 22TM677

Page.: 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.4	44.4	44.539	44.497	44.476	44.506	44.507

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
44.5	0.068	0.030	0.15	2

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

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

**Stability** : One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\*** : Unit Under Calibration

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

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

-o0o-

*Amir*



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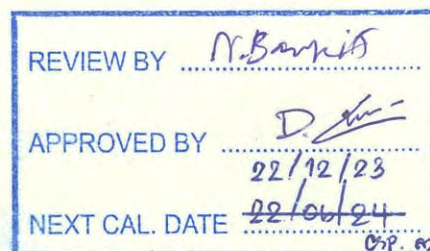


Cert.No.: 22CH1733

Page.: 1 of 3

## Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	SevenExcellence
Serial No. :	B834291445
ID No. :	RYG_EN0152
Condition As-Received:	Used Item
Received Date :	21 December 2022
Calibration Date :	22 December 2022
Reference :	2212-0602DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM) - CP-CH8 by comparison with standard thermometer



Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malu.

Approved Signatory

- ( ☒ ) Malee Butkruea  
( ☐ ) Saithip Meangmai  
( ☐ ) Warakorn Lerngagtrakul

Issue Date : 26 December 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0048758



Cert.No.: 22CH1733

Page.: 2 of 3

**Condition of this calibration result**

1. Reference Standard Instrument : -

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

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

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

**Calibration Results**

**Function : mV Measurement**

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ±mV )	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B834291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

*Malu*



Cert.No.: 22CH1733

Page.: 3 of 3

**Calibration Results****Function : pH Measurement**

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading ( mV )	Uncertainty of pH measurement ( $\pm$ )	Coverage factor $k$
pH Electrode	4.008	4.011	185.2	0.0052	2.06
S/N.: 1475518	6.987	6.990	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

**Function : Temperature Measurement****( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM

- Serial No. : 1475518

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point ( $^{\circ}\text{C}$ )	Standard Temperature ( $^{\circ}\text{C}$ )	UUC* Reading ( $^{\circ}\text{C}$ )	Error ( $^{\circ}\text{C}$ )	Uncertainty of measurement ( $\pm$ $^{\circ}\text{C}$ )	Coverage factor $k$
25.0	25.001	24.9	-0.101	0.13	2.00

**Remark : - UUC\* = Unit Under Calibration**

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

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Malu



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## Certificate of Calibration

Certificate No. : 22E4098

Page : 1 of 2

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenExcellence  
Serial No.: B834291445  
ID No.: RYG\_EN0152  
Condition As-Received: Used Item  
Received Date: 21 December 2022  
Calibration Date: 23 December 2022

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

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

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

### Condition of this result of calibration

1.Reference standards instruments :

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Wutchareeporn Wongchutikrane  
Issue Date : 26 December 2022

Approved Signatory :

☒ Phalinee Prabpaipal

[ ] Nuntawat Khamchai

[ ] Pornthippa Tameyakul

B 0304803



Cert. No.: 22E4098

Page.: 2 of 2

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

<b>Function:</b>	DC voltage measuremer		<b>Range:</b>	2000	mV	
	<b><u>Standard Value</u></b>		<b><u>UUC* Reading</u></b>		<b><u>Error</u></b>	<b><u>Uncertainty</u></b>
	( mV )		( mV )		( mV )	( $\pm \mu V$ )
	-200.0000		-200.0		0.0	72
	-150.0000		-150.0		0.0	69
	-100.0000		-100.0		0.0	65
	-50.0000		-50.0		0.0	62
	0.0000		0.0		0.0	58
	50.0000		50.0		0.0	62
	100.0000		100.0		0.0	65
	150.0000		150.0		0.0	69
	200.0000		199.9		-0.1	72

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

\*UUC= Unit Under Calibration.

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Cert.No.: 22CH283

Page.: 1 of 2

## Certificate of Calibration

<b>Equipment :</b>	Conductivity Meter
<b>Manufacturer :</b>	Mettler Toledo
<b>Model :</b>	S230
<b>Serial No. :</b>	B241407147
<b>ID No. :</b>	RYG_EN0029
<b>Condition As-Received:</b>	Used Item
<b>Received Date :</b>	22 February 2022
<b>Calibration Date :</b>	23 February 2022
<b>Reference :</b>	2202-0732DSC-1
<b>Submitted by :</b>	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
<b>Ambient Temperature :</b>	(25 $\pm$ 2.5) °C
<b>Relative Humidity :</b>	(50 $\pm$ 15) %
<b>Calibration Procedure:</b>	In -house method : - CP-CH6 : based on direct measurement by using certified reference material (CRM)
<b>Calibrated by :</b>	Walalak Sirithean
<b>Approved by :</b>	<u>Malee Butkruea</u> Approved Signatory
	( <input checked="" type="checkbox"/> ) Malee Butkruea ( <input type="checkbox"/> ) Saithip Meangmai ( <input type="checkbox"/> ) Warakorn Lernagatrakul
<b>Issue Date :</b>	25 February 2022



The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Cert.No.: 22CH283

Page.: 2 of 2

**Condition of this result of calibration**

## 1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	211451	15 Apr 2022

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

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

## 2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
84.000 $\mu\text{S/cm}$	CPA Chem	754034	28 June 2022
1413.0 $\mu\text{S/cm}$	CPA Chem	766815	04 Sep 2022
12.880 $\text{mS/cm}$	CPA Chem	761022	02 Aug 2022

- Control Conductivity calibration solution temperature by Water bath ( $25 \pm 0.1$ )  $^{\circ}\text{C}$

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

**Calibration results****Function : Conductivity Measurement**(\*) After Adjustment at 1413.0  $\mu\text{S/cm}$ 

Conductivity Electrode Serial No.: 5821441030

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ( $\pm$ )	Coverage factor k
84.000 $\mu\text{S/cm}$	82.4 $\mu\text{S/cm}$	84.4 $\mu\text{S/cm}$	0.62 $\mu\text{S/cm}$	2.00
1413.0 $\mu\text{S/cm}$	1375 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	9.2 $\mu\text{S/cm}$	2.00
12.880 $\text{mS/cm}$	12.54 $\text{mS/cm}$	12.81 $\text{mS/cm}$	0.086 $\text{mS/cm}$	2.00

**Remark**

- UUC\* = Unit Under Calibration

- Cell constant =  $0.555236 \text{ cm}^{-1}$ 

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

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Malu



From Insight to Outcome

## Agilent CrossLab Start Up Services

### Agilent 5100 5110 ICP-OES Preventive Maintenance

REVIEW BY	<i>Chamath L.</i>
APPROVED BY	<i>Santhu M.</i>
NEXT CAL. DATE	<i>01/03/24</i>

Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

## Introduction

### Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

## Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
  - Sample Prep and Containment
  - Chemical Standards
  - Analysis
  - Service and Support
  - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- **Need to place a service call?** [Flexible Repair Options | Agilent](#)

## Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check **"Service not applicable"** check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- **Ask the customer to sign the Service Verification section including the customer's and your signature.**

## Instrument Maintenance

### System Information

☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID
Instrument System Site and Location

G8010A ; MY16010005  
ALS (BKK)

List System Component Product Numbers	List the Serial Numbers of each Component
1. G8010A	MY16010005
2. G8410A	AU15440764
3. G3292	2008-00159
4. G8485	AU16040115
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	<u>SeaSpray</u>   OneNeb   Conikal   Other
Spray Chamber	<u>Cyclonic Single Pass</u>   Cyclonic Double Pass   Other
Torch	Radial   <u>Dual View</u>   Other
Torch Type	<u>One Piece</u>   Semi Demountable   Fully Demountable   Other
Injector Diameter	2.4mm   <u>1.8mm</u>   1.4mm   0.8mm   Other
Injector Material	<u>Quartz</u>   Ceramic   Other

## Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☒ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☐ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

## Preventive Maintenance Procedures

### Record Pre-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

### Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☒ Replace high capacity air inlet dust filter element if installed.
- ☒ Remove and clean instrument water inlet filter.

### Agilent Water Recirculator

- ☐ **Service not applicable**
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

## SPS 3 Auto Sampler

☒ **Service not applicable**

- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

## SPS 4 Auto sampler

☐ **Service not applicable**

- ☒ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☒ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☒ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☒ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☒ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

## AVS 4, 6, 7 Advanced Valve System

☐ **Service not applicable**

- ☒ Replace valve rotor seal — *inspect*
- ☒ Check fittings for signs of leaks
- ☒ Check tubing including autosampler tubing for kinks or excessive wear
- ☒ Check high flow pump for signs of leaks

## ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

## Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests
  - ☒ Subsystem Communications Test
  - ☒ Air Flow
  - ☒ Water Flow
  - ☒ Gas Flows
  - ☒ RF Generator
  - ☒ Camera Test
  - ☒ Optics Test
  - ☒ Nebulizer Test
- ☒ Record the result in the Instrument Test Results Table

## Restore Instrument

- ☐ For HF applications, ask the customer to reinstall their sample introduction system.
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

## Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☐ **Complete the Signature Page with both Service Engineer and Customer signatures.**

## Test Results

### Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	37,603.8	146,365.1	37,348.7	164,359.5
Mn 257.610 nm SRBR	153,638.7	670,560.3	159,750.0	717,496.1
Al 396.152 nm SBR	28,883.5	200,141.7	28,985.9	196,807.0
K 766.491 nm SBR	99,616.7	3,151,227.8	99,388.4	2,863,954.9

\* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

### Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer test	Pass

## ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode		Plasma On	
Mains Voltage	218.378	VAC	215.135	VAC
Mains Current	0.217	A	0.116	A
Instrument Temperature	24.4	°C	24.3	°C
RF Air Flow (sensor speed)	16.0	Hz	20.0	Hz
Plasma Exhaust Temperature	No measurement		47.3	°C
Water Flow Oscillator	No measurement		1.20	L/min
Water Flow Detector	1.12	L/min	1.09	L/min
Water Inlet Temperature	23.0	°C	23.5	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-40.0	°C	-40.0	°C
Thermal Stabilizer	34.8	°C	35.0	°C
Argon Supply Pressure	613.73	kPa	541.92	kPa
Purge Gas Supply Pressure*1	609.38	kPa	567.77	kPa
Option Gas Supply Pressure*1	—	kPa	—	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		255.76	kPa
Plasma Gas Flow	No measurement		11.98	L/min
Auxiliary Gas Flow	No measurement		1.0	L/min
RF Power	No measurement		1199.9	W
RF Supply Current	No measurement		8.227	A
RF Supply Voltage	No measurement		194.422	V

\*1 If option installed

## Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	1
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	1
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	1
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	1
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	1
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	1
<b>Additional Parts may be required from engineer's stock:</b>			
X axis drive belt	5410047500	SPS 3	1
Z axis drive belt	5410047400	SPS 3	1
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	1

## Consumed Parts Reference (Purchased by customer, not included as part of PM)

☐ Section Not Applicable.

Part Description	Part Number	Product or Model# where used	Quantity consumed
------------------	-------------	------------------------------	-------------------

## Signature Page

### Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

- During PM found water tubing in instrument broken then water leaking inside instrument.
- Replace all water tube inside instrument, after replace found water flow sensor water leak also.
- Replace water module and continue PM without deviation.

## Service Verification

Service Request Number: 6005833474

Date Service Completed: 2 - Mar - 2023

Service Engineer Name: Burin Ngamvijit

Customer Name: Thitima Boonpeng

Service Engineer Signature: Burin Ng.

Customer Signature: Thiti ma. B.

Total number of pages in this document:



Agilent Technologies (Thailand) Limited  
U CHU LIANG BLDG. 22/F UNIT A,D  
968 RAMA 4 ROAD, SILOM, BANGRAK  
Bangkok 10500 Thailand

Tel. +662 637 6363  
Fax: +662 632 4334  
Email: [ccc-smt@agilent.com](mailto:ccc-smt@agilent.com)  
Website: [www.agilent.com/chem](http://www.agilent.com/chem)

**Customer Contact:**

ALS Laboratory Group (Thailand) Co  
Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khwaeng Phatthanakan Khet Suan  
TAX ID : 0105540004859  
Chanattagarn.lmchom@alsglobal.com  
27603068

**Invoice To:**

ALS Laboratory Group (Thailand) Co  
Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khwaeng Phatthanakan Khet Suan

**Delivery Site:**

ALS Laboratory Group (Thailand) Co  
Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khwaeng Phatthanakan Khet Suan

**Location:**

**Room**  
**Bldg**  
**Lab**  
**Dept**

**SERVICE REPORT**

<b>Customer Purchase Order Number:</b>	<b>Customer Number:</b> 70371013
<b>Service Request:</b>	<b>Service Request Date:</b>
<b>Service Order:</b> 6006033911	<b>Service Confirmation:</b> 6904800024

REVIEW BY	Thitima B.
APPROVED BY	Sawitri M.
NEXT CAL DATE	19 Sep 2024

**Direct Inquiries to:**

Contact Name: Customer Contact Center  
Contact E-mail: [ccc-smt@agilent.com](mailto:ccc-smt@agilent.com)  
Contact Telephone: +662 637 6363  
Contact Fax: +662 632 4334

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U Chu Liang Bldg. 22/F Unit A,D  
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Bangkok 10500 Thailand  
Tax ID : 0105542068218

Citibank N.A. Bangkok Branch  
399 Interchange 21 Building, Sukhumvit Road, Klongtoey Nau  
Sub-district, Wattana District, Bangkok 10110 Thailand  
Acc. No: 012-4452-007 ,  
THB:Krung Thai Bank PCL  
Siam Square Br.,416/1-2 Rama I Rd.,Pathumwan, BKK 10330  
Thailand

ORIGINAL

**Service Confirmation Number:** 6904800024

**Service Confirmation Date:** 20.03.2023

**Service Instrument:**

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IO-5100	ICP-OES 5100/5110 System			
G8010A	Agilent 5100 SVDV ICP-OES Spectrometer	MY16010005	ICP OES 5100	SYS-IO-5100
G8410A	SPS 4 Autosampler	AU15440764	ICP OES 5100	SYS-IO-5100

**Service Items:**

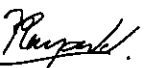

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EOQ	Enterprise Operational Qualification	1.00	Agreement Entitlement - 100 % covered	20.03.2023	20.03.2023

**Additional Information:**

Service Confirmation Number: 6904800024

Service Confirmation Date: 20.03.2023

**Service Information:**

<b>Problem Description:</b> WU-S-OQ-IO-5100-5001143313		
<b>Service Provided:</b> Complete OQHW 5100ICPOES Equipment ID: BKK_EL0037, all tests passed		
<b>Service Overview Code:</b> Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
<b>Reported Hours:</b> 4.0	<b>Travel Hours:</b> 2.0	
<b>Customer Field Service Representative Name:</b> Kanyakorn Sukpathrajarern	<b>Customer Field Service Representative Signature:</b> 	<b>Date:</b> 20 Mar 2023
<b>Customer Name:</b> Thitima Boonpeng	<b>Customer Signature:</b> 	<b>Date:</b> 20 Mar 2023
<b>Additional Comments:</b>		



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 23TM637  
Page : 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNE 45  
Serial No. : L712.0429  
ID No. : BKK\_ML0056  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
Location : Incubator & Microbiological Reading  
Received Order : 20 April 2023  
Calibration Date : 20 April 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Kunchit Promprat

REVIEW BY	Sithichok
APPROVED BY	
NEXT CAL. DATE	20/4/24

Approved by :

Malee

Approved Signatory

- ( ) Pornthippa Tameyakul  
( / ) Malee Butkruea  
( ) Suwit Imjai

Issue Date :

24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0053357



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2304-0253OC-1

Cert. No.: 23TM637

Page : 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1 ) Data Acquisition	34970A	MY44073381	22LM78/1	12 May 2023

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

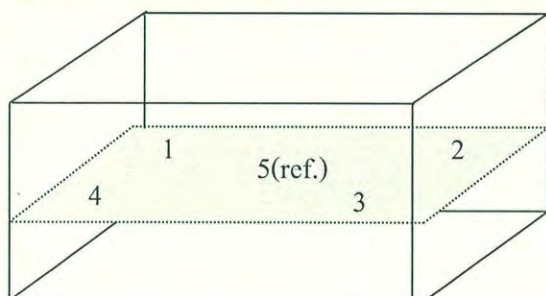
3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Heat transfer medium used :** Water

	<u>Environmental</u>		<u>AC Voltage Supply</u>
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	25	45	223
Finished of Calibration	25	43	223



Front

<u>Position :</u>	<u>Ref. Std. S/N.:</u>
1	4803988-006
2	4803988-007
3	4804539-014
4	4804539-015
5(ref.)	4804539-016

Malu .



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2304-0253OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 23TM637

Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )					Uncertainty  ( ± °C )
			Position					
			1	2	3	4	5 (ref.)	
44.5	44.5	44.5	44.492	44.463	44.475	44.510	44.491	0.15
45.0	45.0	45.0	45.005	44.962	44.979	45.016	44.986	0.15

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Coverage Factor <i>k</i>
44.5	0.051	0.022	2
45.0	0.080	0.026	2

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

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

**Stability** : One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\*** : Unit Under Calibration

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

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

-o0o-

Malu

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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

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



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**REVIEW BY Thavitall.APPROVED BY D. [Signature]NEXT CAL. DATE 01/03/24

# Certificate of Calibration

Model Number : MSE224S-100-DUCertificate No. : 23BCI0112Description : Analytical BalanceIssued Date : Friday, March 03, 2023Serial Number : 0026207038Reference No. : 204833ID No. : RYG\_EN0002Manufacturer : SartoriusPage No. : 1 of 2Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong.21140, Thailand.Calibrated By : Mr.Chonchai InthanaCalibration Date : Wednesday, March 01, 2023

Calibration

Procedure No. : This calibration was conducted byUsing in-house calibration procedure number (WI-003)Based on UKAS LAB 14 : 2019**Metrological data :**Capacity : 220 g Readability : 0.0001 g**Ambients Conditions:**Temperature : 23.6 °C ± 5.0 °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 form 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.

Mr.chonchai Inthana(Technical Manager)

S  
T  
A  
M  
P

# Certificate of Calibration

Model Number : MSE224S-100-DU

Certificate No. : 23BCI0112

Description : Analytical Balance

Issued Date : Friday, March 03, 2023

Serial Number : 0026207038

Reference No. : 204833

ID No. : RYG\_EN0002

Manufacturer : Sartorius

Page No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

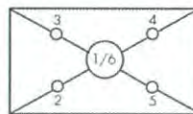
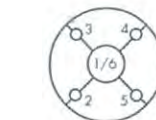
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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

### Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of 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 : 100 g  
Tolerance 0.0004 g



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

### Linearity

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

Tolerance 0.0002 g

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

End of Report.



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1492

Page : 1 of 3

## Certificate of Calibration

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

**Calibrated by :** Preecha Hlahib

**Approved by :**

*Malu.*

Approved Signatory

- ( ☒ ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ☐ ) Suwit Imjai

**Issue Date :** 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-0376OC-1

Cert. No.: 22TM1492  
 Page : 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

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

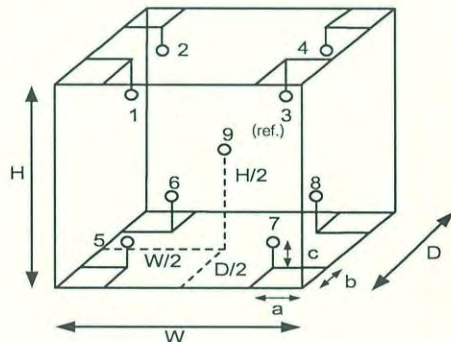
3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	28	29
REL.Humid. ( % )	43	47
AC Supply ( Volt )	220	221



Position :	Ref. Std. ID No.:
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.33 m  
 W = 0.40 m  
 H = 0.40 m  
 Capacity = 0.053 m<sup>3</sup>

*Malu .*



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM1492

Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149	70.328

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

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

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

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

**UUC\*** : Unit Under Calibration

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

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

-o0o-

*Malu.*



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1491

Page : 1 of 3

## Certificate of Calibration

<b>Equipment :</b>	Water Bath
<b>Manufacturer :</b>	Memmert
<b>Model :</b>	WNB22
<b>Serial No. :</b>	L513.0648
<b>ID No. :</b>	RYG_EN0061
<b>Submitted by :</b>	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
<b>Location :</b>	Wet Chemistry Lab
<b>Received Order :</b>	20 October 2022
<b>Calibration Date :</b>	20 October 2022
<b>Ambient Temperature :</b>	( 26 ± 10 ) °C
<b>Relative Humidity :</b>	( 50 ± 30 ) %
<b>Calibrated by :</b>	Preecha Hlahib



Approved by :

Approved Signatory

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

Issue Date :

2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2210-0376OC-4

Cert. No.: 22TM1491

Page : 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

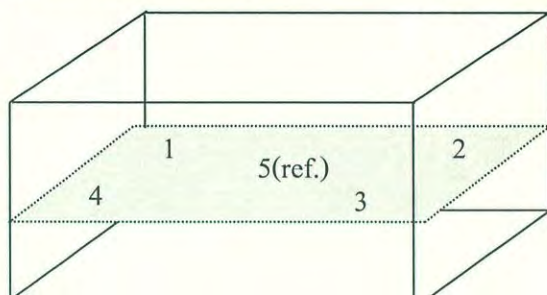
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730

Malu



Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2210-0376OC-4  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 22TM1491  
Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.580

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
85.0	0.12	0.081	0.18	2

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

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

**Stability** : One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\*** : Unit Under Calibration

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

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

-o0o-

Malu.



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T221642

Page 1 of 5

## Certificate of Calibration

Equipment : Digestion Unit

Manufacturer : SCP Science

Model : DigiPRER HT

Serial No. : HTC1120480658

Customer Code : BKK\_EN0366

ID No. : T2635A5

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.


104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

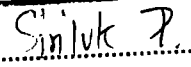

Customer Location : Wet Chemistry Lab 1

Date of Receipt : 27 June 2022

Calibrated By : Sujjar Naknakred ( Site Calibration Manager )

Approved By :  / Boonchai Suriyawong ( Site Calibration Manager )

Date of Issue : 04 JUL 2022

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	30/06/23

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T221642

Page 2 of 5

## Calibration Report

Equipment : Digestion Unit  
Date of Calibration : 30 June 2022  
Environment : Temperature : 23.9 - 26.3 °C  
Line Voltage : 221.4 - 225.1 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert four standard thermocouples type S into its chamber , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T10.

#### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	Type S	M7-(CH16-17,CH19-CH20)	T212004	15 October 2022
DATA LOGGER	34970A	T121	T212004	15 October 2022

#### 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

#### 4. Condition of calibrated item : good

##### Equipment Description :

Time Constant - Hour 26 Minute At 380 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

#### 5. Adjustment :

( X ) without adjustment

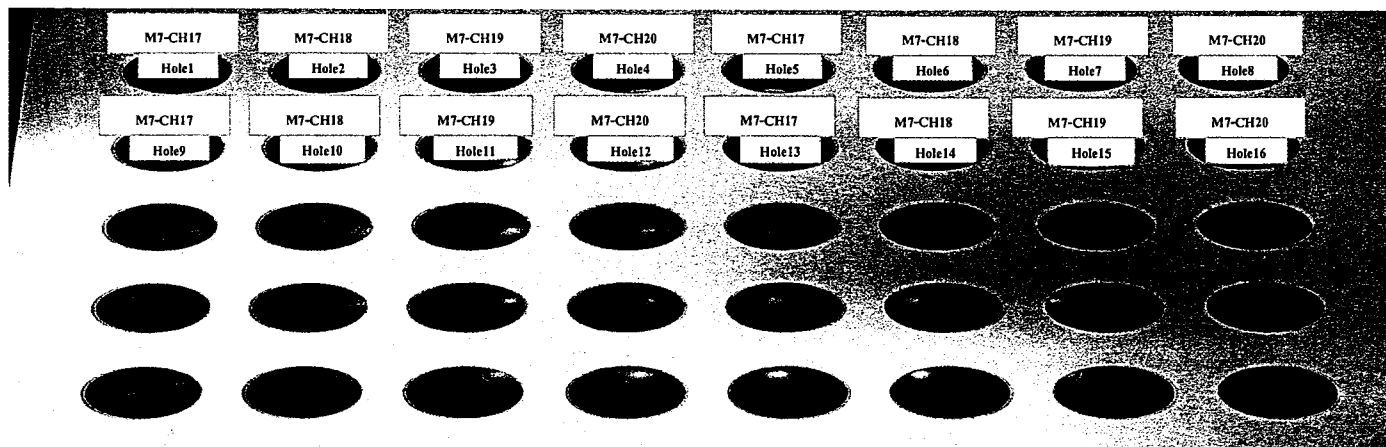
( ) after adjustment

Approved By. 

Certificate No. T221642

Page 3 of 5

## Calibration Report



FRONT

### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
°C	°C	°C	Reading	Hole1	Hole2	Hole3	Hole4	Hole5	Hole6	Hole7	Hole8
				M7-CH17	M7-CH18	M7-CH19	M7-CH20	M7-CH17	M7-CH18	M7-CH19	M7-CH20
380.0	380.0	379.4 - 380.7	Max °C	379.1	379.8	379.3	377.4	377.6	379.3	379.6	377.9
			Min °C	378.7	379.4	378.9	377.0	377.3	378.8	379.1	377.3
			Average °C	378.9	379.6	379.1	377.2	377.4	379.1	379.3	377.6
			Stability ± °C	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
°C	°C	°C	Reading	Hole9	Hole10	Hole11	Hole12	Hole13	Hole14	Hole15	Hole16
				M7-CH17	M7-CH18	M7-CH19	M7-CH20	M7-CH17	M7-CH18	M7-CH19	M7-CH20
380.0	380.0	379.4 - 380.7	Max °C	378.5	378.8	378.1	379.0	380.3	381.6	381.0	379.5
			Min °C	377.8	378.2	377.6	378.6	379.9	381.2	380.5	378.9
			Average °C	378.2	378.5	377.9	378.8	380.1	381.4	380.7	379.2
			Stability ± °C	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3

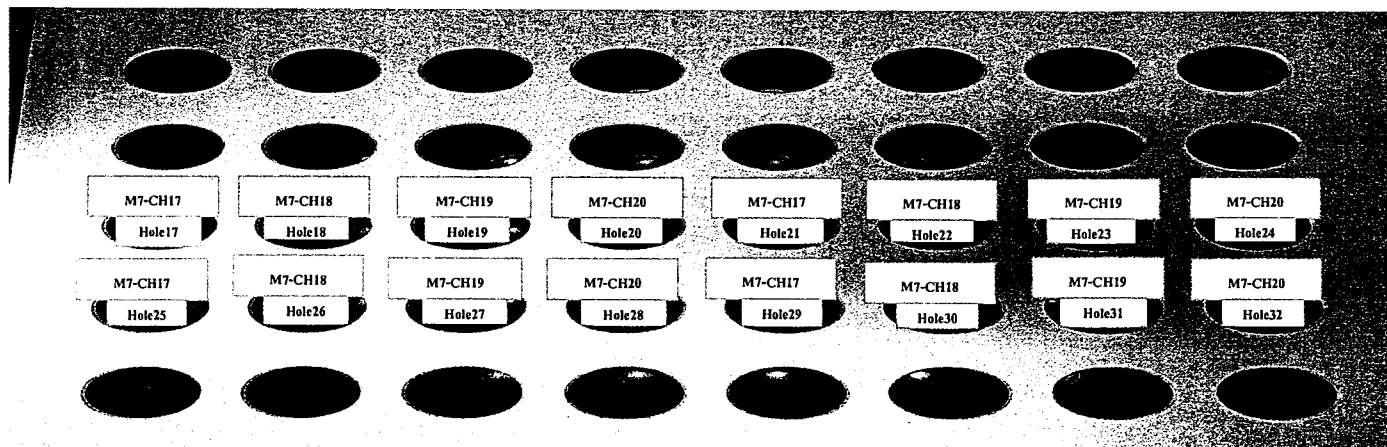
Approved By.



Certificate No. T221642

Page 4 of 5

## Calibration Report



FRONT

### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	Hole17	Hole18	Hole19	Hole20	Hole21	Hole22	Hole23	Hole24
				M7-CH17	M7-CH18	M7-CH19	M7-CH20	M7-CH17	M7-CH18	M7-CH19	M7-CH20
380.0	380.0	379.4 - 380.7	Max °C	378.4	378.8	378.0	379.2	379.0	382.0	381.5	380.3
			Min °C	377.8	378.2	377.7	378.8	378.7	381.5	381.1	379.6
			Average °C	378.1	378.5	377.9	379.0	378.9	381.8	381.3	379.9
			Stability ± °C	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.4

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	Hole25	Hole26	Hole27	Hole28	Hole29	Hole30	Hole31	Hole32
				M7-CH17	M7-CH18	M7-CH19	M7-CH20	M7-CH17	M7-CH18	M7-CH19	M7-CH20
380.0	380.0	379.4 - 380.7	Max °C	378.3	378.7	378.4	378.8	379.6	382.6	382.0	380.8
			Min °C	377.6	378.3	377.9	378.4	379.3	382.2	381.4	380.0
			Average °C	378.0	378.5	378.1	378.6	379.5	382.4	381.7	380.4
			Stability ± °C	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.4

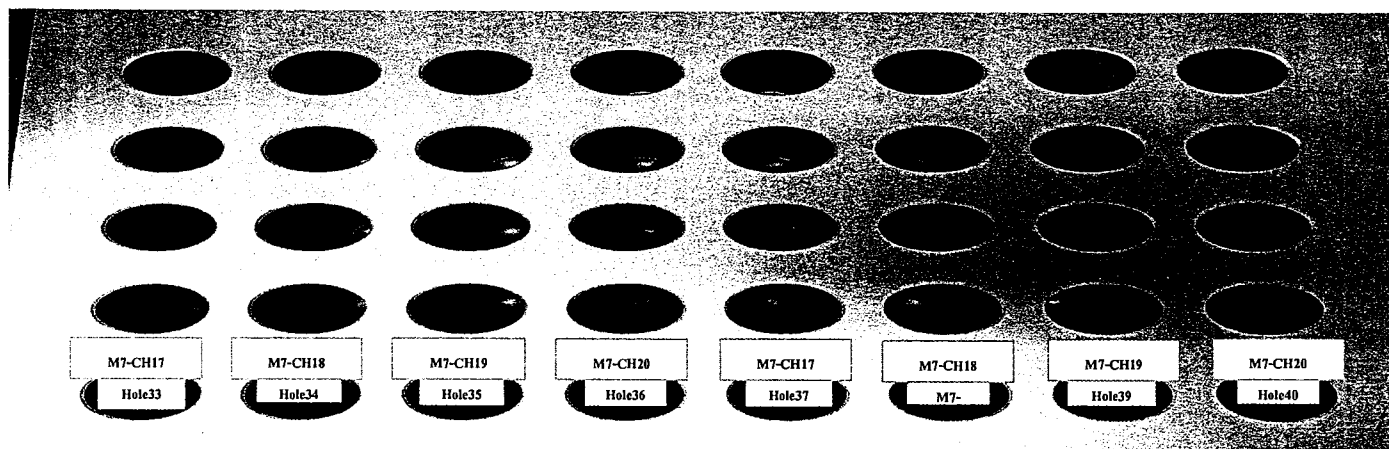
Approved By.



Certificate No. T221642

Page 5 of 5

## Calibration Report



FRONT

### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	Hole33	Hole34	Hole35	Hole36	Hole37	Hole38	Hole39	Hole40
				M7-CH17	M7-CH18	M7-CH19	M7-CH20	M7-CH17	M7-CH18	M7-CH19	M7-CH20
380.0	380.0	379.4 - 380.7	Max °C	378.6	376.7	377.2	378.0	380.0	382.2	381.5	379.7
			Min °C	378.1	376.2	376.7	377.5	379.5	381.7	380.9	379.1
			Average °C	378.3	376.5	377.0	377.7	379.8	381.9	381.2	379.4
			Stability ± °C	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

 The expanded uncertainty of temperature measurement was  $\pm 2.49$  °C

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

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

Approved By.





บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด  
DOUBLE S DIAGNOSTICS CO., LTD.

4 ซอยอุดมสุข 14 แขวงบางนา เขตบางนา กรุงเทพฯ 10260 โทรศัพท์: (02) 747-7009 โทรสาร: (02) 747-7008  
4 Soi Udomsuk 14, Bangna, Bangkok 10260 Tel. (02) 747-7009 Fax: (02) 747-7008

Maintenance Plan YEAR : 2023

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รอบ	PM-6M ck											

Periodical maintenance check list for Konelab

	6M	12M	Note!
1.Diluent-wash tubing change	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2.ISE tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	none.
3.Syringe check/change		<input type="checkbox"/>	
4.Dispensing check/ change		<input type="checkbox"/>	
5.Waste tubing change when necessary		<input type="checkbox"/>	
6.Lamp check/change	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
7.Mixer paddle/paddle change(not Konelab20)		<input type="checkbox"/>	
8.ISE needles check/change		<input type="checkbox"/>	
9.Pump tubing check/ chance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
10.Broken/worn out part check /change		<input type="checkbox"/>	
11.Peristaltic pump check /cleaning/ lubrication	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
12.Heating check		<input type="checkbox"/>	
13.Cooling check		<input type="checkbox"/>	
14.Dispenser mechanic check/adjustment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
15.Cuvette transfer mechanic check/adjustment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
16.Dispenser movement check/adjustment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
17.Sample/reagent register check/adjustment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
18.Dispensing tubing tightness check	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
19.Photometer and optics cleaning/check/adjustment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
20.Workstation PC cleaning if necessary	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
21.Mechanic cleaning/lubrication	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
22.Instrument cleaning if necessary	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
23.Complete analyzer testing with waterblank/QC or sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
24.Test parameters/Adjustment/config. Save to USB key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
25.UPS Test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Place: ALS Laboratory Instrument: Konelab Aquakem 250  
Date/Time: 05-01-66 Serial no: 22781  
Service done by: M. S. S. Install date:  
Signature of customer: Date/Time:

# 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 :

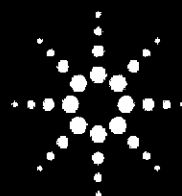
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 8:49:59 AM	Audit	SessionCreated	Session	None
September 8, 2021 8:49:59 AM	Start	Configuration	Session	None
September 8, 2021 8:49:59 AM	Audit	Entitlement	Licensing	User Is FieldEngineer and does not require 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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Instrument Tests : 5100 SVDV	10
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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

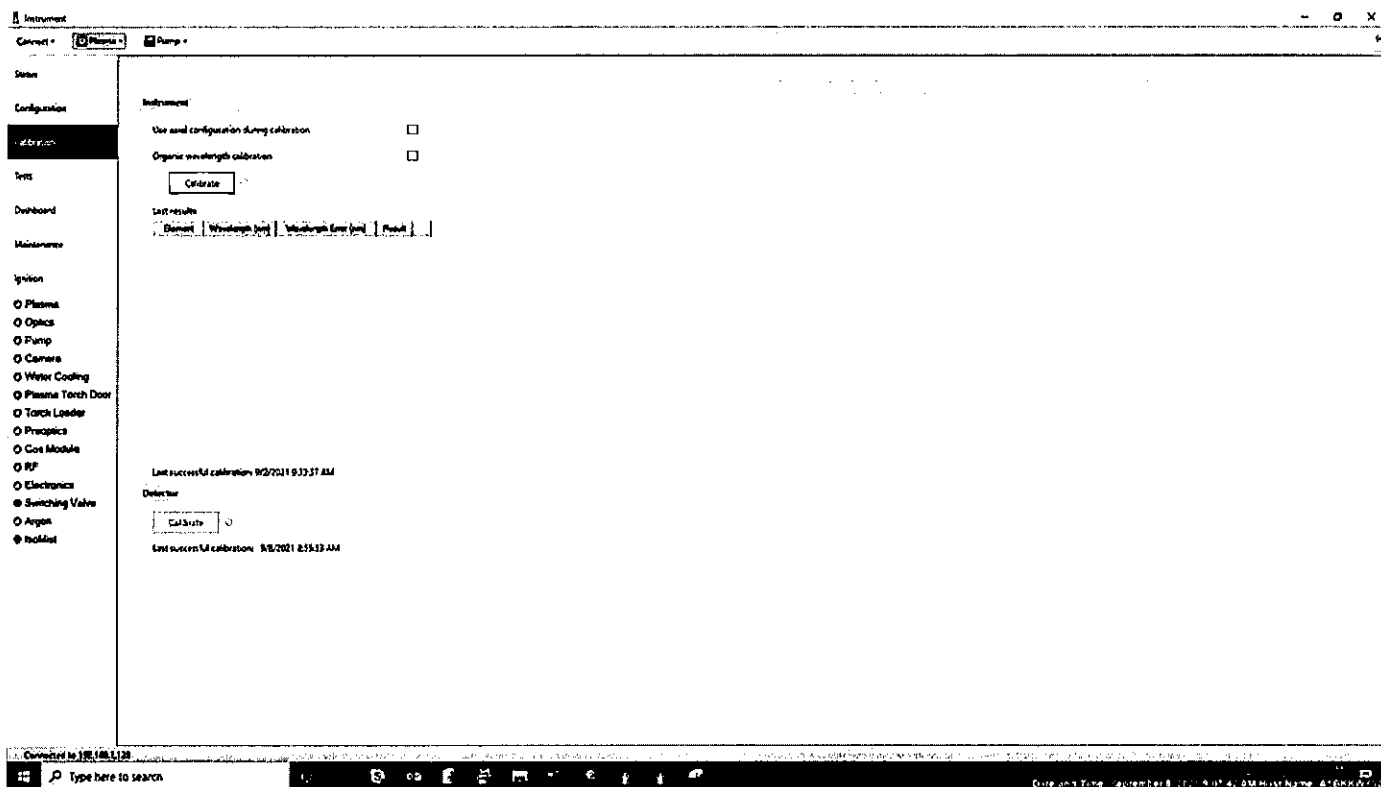


Image Details:

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 'Instrument' section is expanded, showing 'Use axial configuration during calibration' (checked) and 'Organic wavelength calibration' (unchecked). Below this is a 'Calculate' button. The 'Last results' table shows calibration data for various elements, with all results marked as 'Pass'. The 'Detector' section also has a 'Calculate' button and shows the last successful calibration date as 9/8/2021 9:33:07 AM.

Element	Wavelength (nm)	Wavelength Error (nm)	Result
Al	167.019	0.008147	Pass
H	174.213	0.001644	Pass
As	186.94	-0.001433	Pass
C	193.017	0.003076	Pass
As	193.096	0.002620	Pass
Se	196.016	0.004831	Pass
Mo	202.032	-0.000304	Pass
Zn	202.543	-0.006679	Pass
Mo	203.848	0.004706	Pass
Mo	254.596	0.000782	Pass
Cr	265.36	-0.002789	Pass
Zn	213.857	-0.004794	Pass
Cd	214.439	-0.006227	Pass
Pb	220.353	-0.005075	Pass

Last successful calibration: 9/8/2021 9:33:07 AM

Detector

Calculate

Last successful calibration: 9/8/2021 9:33:33 AM

## 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	7440-66-6	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:**  
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**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.

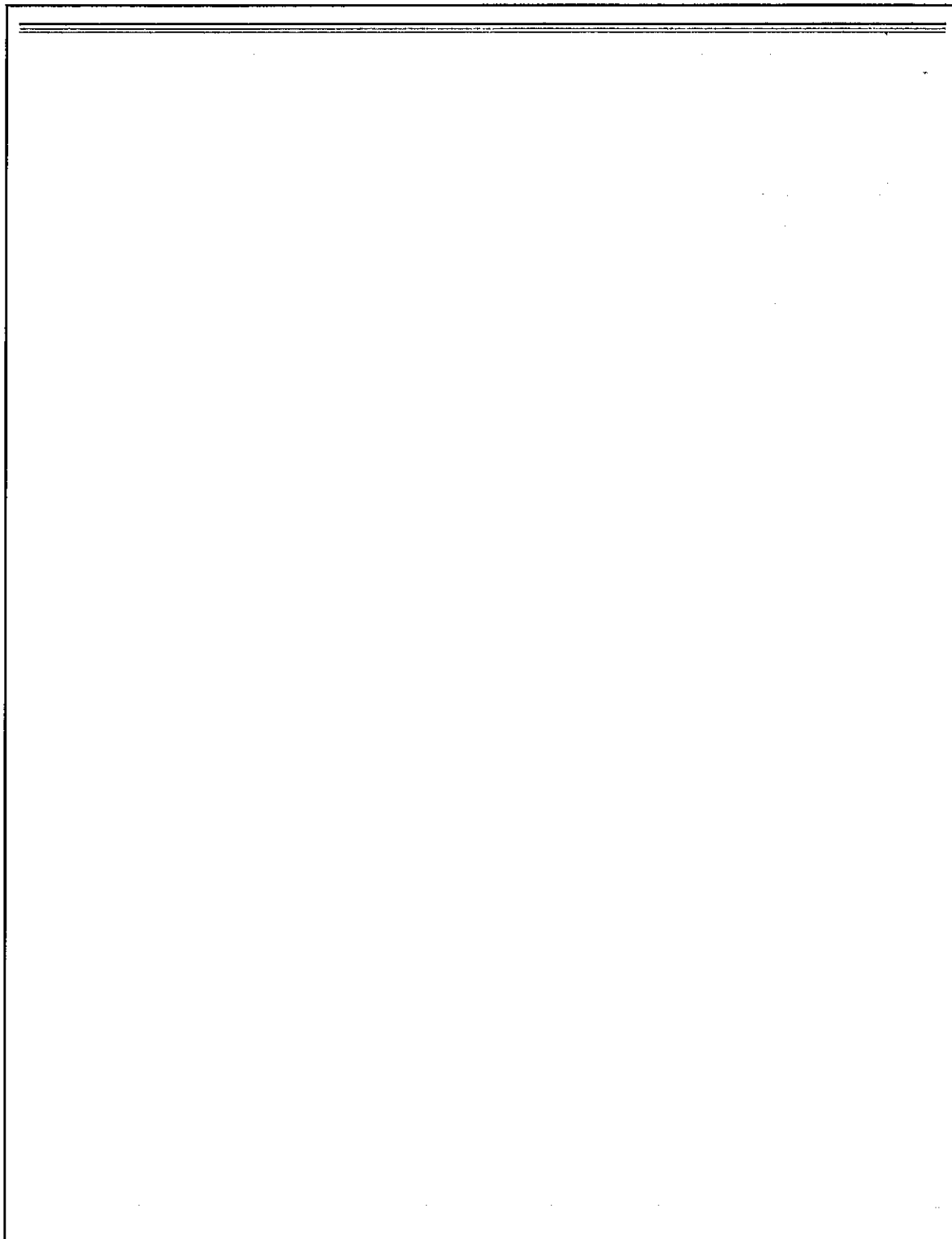
**Further Information:** Please contact Agilent for further information about this CRM.

**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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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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**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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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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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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## 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 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

### 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: phlmpapha.jeeraphong  
 Hostname: ASBKKWX328

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 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

QQHW 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: ASBKKWX328

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

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

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# Maintenance Protocol

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Atomic Fluorescence Spectrometer  
**mercur / mercur plus**

---

Serial-No.:

1700124

Customer-No.:

$$\text{COH} - \text{CO}_2$$

Date:

7/06/2022.

Carried out by:

Mr. Srichan Park-on

☐

(requires a separate OQ protocol)

<b>Company</b>	דפוס 10/100/10x ממוסמך על כלכלה, ערב.
<b>User</b>	קונסטנטין מרזלר,
<b>Department</b>	Lab
<b>Street</b>	104 סנדוויטש 40 ממזרח ממוסמך
<b>Zip Code, City</b>	ממוסמך ממוסמך 10250
<b>Country</b>	Leinewe.
<b>Phone</b>	
<b>Fax</b>	
<b>E-mail</b>	

### Maintenance works basic unit

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

### Maintenance works Autosampler

Serial No.:

701 239

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

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

Device parameter	nominal value	actual value
<b>Analytical parameters</b>		
Conditions.: max.conc.: 10µg/L PMT-voltage: ..... <u>404</u> .....V		
Blank-solution		Int ..... <u>0.0005</u>
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int <sub>1</sub> ..... <u>0.0026</u> RSD..... <u>1.12</u> %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: ..... <u>395</u> .....V		
Blank-solution		Int..... <u>0.0018</u>
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int <sub>2</sub> ..... <u>0.0104</u> RSD..... <u>0.59</u> %
Fok.- factor ( Int <sub>2</sub> / Int <sub>1</sub> )	> 3,5	<u>4</u>
<b>Comments</b>		

Mr. Srichai Fak-on -  
Signature Technician

Bangkok., 2/06/2022.  
Place, Date (DD/MM/YYYY)

สตีเฟ่น งามรุ่งโรจน์  
Signature Customer

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