

ภาคผนวก จ

ใบรับรองผลการสอบเทียบเครื่องมือ



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

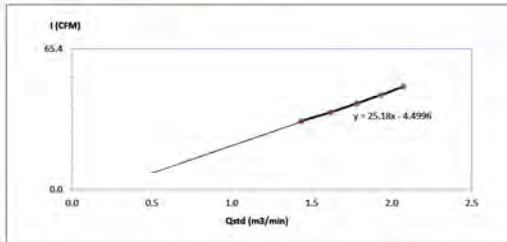
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0386	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1063	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0387	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0004	8-Feb-23	8-Feb-24	12
Ambient	Total Suspended Particulate	High Volume	BKK_FS1058	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0373	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0004	8-Feb-23	8-Feb-24	12
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1071	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1085	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0772	4-Jan-23	4-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS1072	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS1086	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0773	5-Jan-23	5-Jul-23	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direct	BKK_FS0917	1-Nov-21	2-May-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direct	RYG_FS0436	5-Jan-23	5-Jan-24	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direct	BKK_FS0975	5-Jan-23	5-Jan-24	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0631	20-Dec-22	20-Dec-23	18
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0135	24-May-22	24-May-23	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0131	24-May-22	24-May-23	12
Noise	Leq 5 min	Sound Calibrator	BKK_FS0631	20-Dec-22	20-Dec-23	18
Noise	Leq 5 min	Sound Level Meter	BKK_FS0135	24-May-22	24-May-23	12
Noise	Leq 5 min	Sound Level Meter	BKK_FS0131	24-May-22	24-May-23	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0631	20-Dec-22	20-Dec-23	18
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0135	24-May-22	24-May-23	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0131	24-May-22	24-May-23	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0130	24-May-22	24-May-23	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0631	20-Dec-22	20-Dec-23	18
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0136	24-May-22	24-May-23	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0133	24-May-22	24-May-23	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0134	24-May-22	24-May-23	12



High Volume Air Sampler Calibration Worksheet

Project Site :	Wellgrow Industries Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	วัดนวมินทร์	Temperature (°C) :	32
Calibrate Date :	23-Mar-23	High Volume ID :	BKK FS0386
CalibrationSheet No.:	C-230323-BKK FS0386	High Volume Model :	TE-5009X
Calibrator ID:	BKK FS0624	High Volume S/N :	4790
Calibrator Model :	TE-5028A	Calibrator Slope :	1.0268
Calibrator S/N :	2584	Calibrator Intercept :	-0.01116

Test No.	Delta H ₂ O (inch)	Q _{as} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	2.2	1.4352	32	Slope : 25.1801 Intercept : -4.4996 Correlation Coefficient : 0.9905
2	2.8	1.6177	36	
3	3.4	1.7815	40	
4	4.0	1.9314	44	
5	4.6	2.0704	48	



Calibrated by :
(Mr. Teeravut Sukdee)
Field Scientist(1)

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

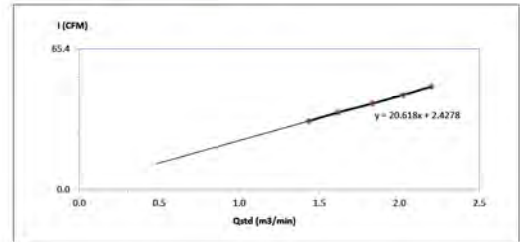
FORM NO.: F06-074 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site :	Wellgrow Industries Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	วัดนวมินทร์	Temperature (°C) :	32
Calibrate Date :	23-Mar-23	High Volume ID :	BKK FS1063
CalibrationSheet No.:	C-230323-BKK FS1063	High Volume Model :	TE-5009X
Calibrator ID:	BKK FS0624	High Volume S/N :	5685
Calibrator Model :	TE-5028A	Calibrator Slope :	1.0268
Calibrator S/N :	2584	Calibrator Intercept :	-0.01116

Test No.	Delta H ₂ O (inch)	Q _{as} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	2.2	1.4352	32	Slope : 20.6180 Intercept : 2.4278 Correlation Coefficient : 0.9995
2	2.8	1.6177	36	
3	3.6	1.8329	40	
4	4.4	2.0251	44	
5	5.2	2.2006	48	



Calibrated by :
(Mr. Teeravut Sukdee)
Field Scientist(1)

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

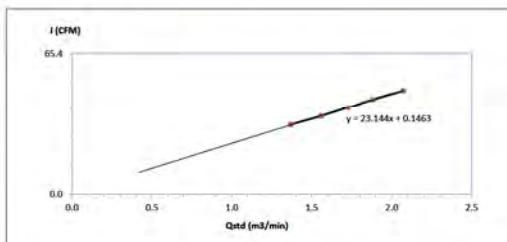
FORM NO.: F06-074 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site :	Wellgrow Industries Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	วัดนวมินทร์ (A5)	Temperature (°C) :	32
Calibrate Date :	23-Mar-23	High Volume ID :	BKK FS0387
CalibrationSheet No.:	C-230323-BKK FS0387	High Volume Model :	G1051
Calibrator ID:	BKK FS0624	High Volume S/N :	1626
Calibrator Model :	TE-5028A	Calibrator Slope :	1.0768
Calibrator S/N :	2584	Calibrator Intercept :	-0.01116

Test No.	Delta H ₂ O (inch)	Q _{as} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	2.0	1.3690	32	Slope : 23.1436 Intercept : 0.1463 Correlation Coefficient : 0.9994
2	2.6	1.5593	36	
3	3.2	1.7287	40	
4	3.8	1.8828	44	
5	4.6	2.0704	48	



Calibrated by :
(Mr. Teeravut Sukdee)
Field Scientist(1)

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

FORM NO.: F06-074 REVISION NO.: ISSUE DATE: 14/03/16

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8361-6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

of Calibration

REVIEW BY :
APPROVED BY :
NEXT CAL. DATE : 8/2/24

Model Number : XP105DU
Description : Semi-micro Balance
Serial Number : 1123091884
ID No. : BKK_EN0004
Manufacturer : Mettler Toledo

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

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

Calibrated Place : Balance Room.

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

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

Metrological data :
Capacity : 31/120 g Readability : 0.0001 g

Ambients Conditions :
Temperature : 21.0 °C ± 3.0 °C
Humidity : 65.0 % RH ± 5.0 % RH
Pressure : ±

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

Equipment Condition : ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref : Lab 14

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

Traceability:

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

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

Mr. Chonchai Inthana (Technical Manager)



Certificate of Calibration

Model Number : XP105DU
Description : Semi-micro Balance
Serial Number : 1123091884
ID No. : BKK_EN0004
Manufacturer : Mettler Toledo

Certificate No. : 23BCI0071
Issued Date : Monday, February 13, 2023
Reference No. : 203245
Page No. : 2 of 3

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The reproducibility is the ability of a weighing instrument to display nearly identical readings 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.			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 : (Low Load)	2.00002	20.00002	Nominal value : 20	g	
2 g	2.00001	20.00001	Tolerance	N/A	g
Tolerance	2.00002	20.00001			
N/A g	2.00002	20.00001			
	2.00002	20.00000			
Nominal Value : (High Load)	2.00002	20.00000			
20 g	2.00002	20.00001			
Tolerance	2.00002	20.00000			
N/A g	2.00001	20.00000			
	2.00001	20.00001			
Standard Deviation	0.000005	0.000007			

Linearity				
The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	N/A	g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.1	0.10000	0.10000	0.00000	0.000022
0.5	0.50001	0.50000	-0.00001	0.000023
1	1.00000	1.00000	0.00000	0.000024
2	2.00002	2.00001	-0.00001	0.000026
5	5.00002	5.00002	0.00000	0.000030
10	10.00002	10.00002	0.00000	0.000035
15	15.00004	15.00004	0.00000	0.000053
20	20.00000	20.00000	0.00000	0.000053
25	25.00002	25.00002	0.00000	0.000089
30	30.00002	30.00004	0.00002	0.000089

SOP FM 33 03 February 2022

Certificate of Calibration

Model Number : XS105DU
Description : Semi-micro Balance
Serial Number : 1123091884
ID No. : BKK_EN0004
Manufacturer : Mettler Toledo

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

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The reproducibility is the ability of a weighing instrument to display nearly identical readings 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.			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 : (Low Load)	100.0000	100.0000	Nominal value : 9	g	
100 g	100.0000	100.0000	Tolerance	N/A	g
Tolerance	100.0000	100.0000			
N/A g	100.0000	100.0000			
	100.0000	100.0000			
Nominal Value : (High Load)	100.0000	100.0000			
100 g	99.9999	100.0000			
Tolerance	100.0000	100.0000			
N/A g	100.0000	100.0000			
Standard Deviation	0.00003				

Linearity				
The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	N/A	g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
50	50.0000	50.0000	0.0000	0.00012
55	55.0000	55.0000	0.0000	0.00015
60	60.0000	60.0000	0.0000	0.00015
65	65.0001	65.0001	0.0000	0.00015
70	70.0000	70.0000	0.0000	0.00015
80	80.0000	80.0000	0.0000	0.00017
90	90.0001	90.0001	0.0000	0.00018
100	100.0000	100.0000	0.0000	0.00018
110	110.0000	110.0000	0.0000	0.00026
120	120.0000	120.0000	0.0000	0.00026

SOP FM 33 03 February 2022

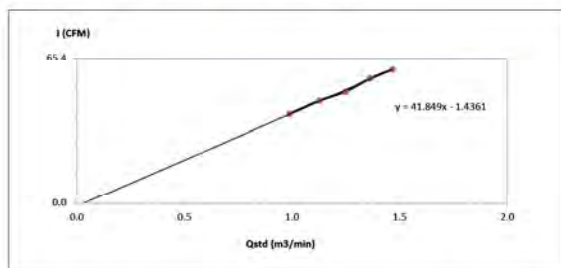


High Volume Air Sampler Calibration Worksheet

Project Site : Wellgrow Industries Co., Ltd.
Calibrate Location : โรงงานอุตสาหกรรม (A2)
Calibrate Date : 23-Mar-23
CalibrationSheet No. : C-230323-BKK FS1058
Calibrator ID : BKK FS0624
Calibrator Model : TE-S028A
Calibrator S/N : 2584

Barometric Pressure (mm Hg) : 756
Temperature (°C) : 32
High Volume ID : BKK FS1058
High Volume Model : TE-S009X
High Volume S/N : 5689
Calibrator Slope : 1.63932
Calibrator Intercept : -0.01785

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	0.9875	40	Slope: 41.8486 Intercept: -1.4361 Correlation Coefficient: 0.9970
2	3.4	1.1267	46	
3	4.2	1.2503	50	
4	5.0	1.3626	56	
5	5.8	1.4662	60	



Calibrated by :
(Mr. Teeravut Sukdee)
Field Scientist (1)

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

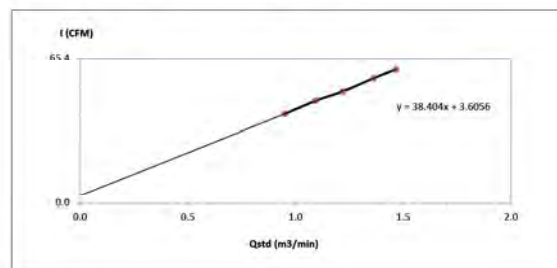


High Volume Air Sampler Calibration Worksheet

Project Site : Wellgrow Industries Co., Ltd.
Calibrate Location : โรงงานอุตสาหกรรม (A2)
Calibrate Date : 23-Mar-23
CalibrationSheet No. : C-230323-BKK FS0365
Calibrator ID : BKK FS0624
Calibrator Model : TE-S028A
Calibrator S/N : 2584

Barometric Pressure (mm Hg) : 756
Temperature (°C) : 32
High Volume ID : BKK FS0365
High Volume Model : TE-S009X
High Volume S/N : 4164
Calibrator Slope : 1.63932
Calibrator Intercept : -0.01785

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.4	0.9495	40	Slope: 38.4037 Intercept: 3.6056 Correlation Coefficient: 0.9992
2	3.2	1.0936	46	
3	4.0	1.2206	50	
4	5.0	1.3626	56	
5	5.8	1.4662	60	



Calibrated by :
(Mr. Teeravut Sukdee)
Field Scientist (1)

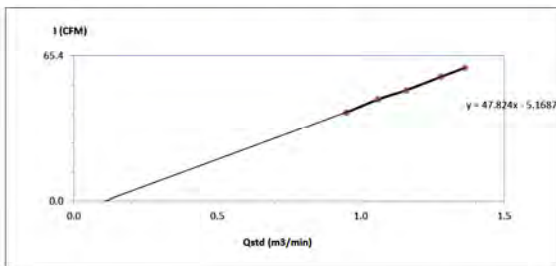
Approved by :
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: Wellgrow industries Co., Ltd. Barometric Pressure (mm Hg): 759
 Calibrate Location: ๕๖๖๖๖๖ (A3) Temperature (°C): 32
 Calibrate Date: 23-Mar-23 High Volume ID: BKK_FS0373
 Calibration Sheet No.: C-230323-BKK_FS0373 High Volume Model: G1051
 Calibrator ID: BKK_FS0624 High Volume S/N: 1338
 Calibrator Model: TE-S028A Calibrator Slope: 1.63932
 Calibrator S/N: 2584 Calibrator Intercept: -0.01785

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.4	0.9495	40	Slope: 47.8249 Intercept: -5.1687 Correlation Coefficient: 0.9993
2	3.0	1.0595	46	
3	3.0	1.1589	50	
4	4.4	1.2793	56	
5	5.0	1.3626	60	



Calibrated by: [Signature]
 (Mr. Teeravut Sukdee)
 Field Scientist(1)

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

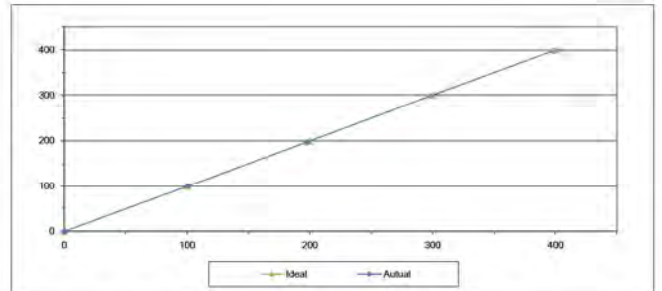
FORM NO.: F-06-073 REVISION NO.: ISSUE DATE: 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-23 Equipment Name: SO2 Analyzer
 Manufacturer: HORIBA Model: APSA-370
 Serial No.: R0H40S60 Equipment ID: BKK_FS1071
 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	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.30	1.30	1.30
2	200.00	197.30	-2.70	-1.35
3	300.00	298.50	-1.50	-0.50
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				-0.19



Calibrated By: [Signature]
 (Mr. Jirawut Sakarn)
 Field Environmental Scientist (3)

Approved By: [Signature]
 (Mr. Sarayuth Jitranont)
 Assistant General Manager

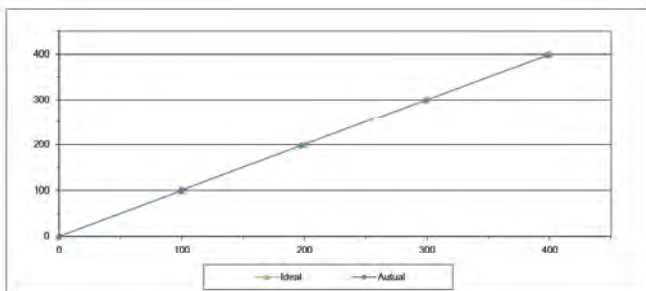
ALS Laboratory Group
 FORM NO.: F-06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-23 Equipment Name: SO2 Analyzer
 Manufacturer: HORIBA Model: APSA-370
 Serial No.: 42B579RC Equipment ID: BKK_FS1085
 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	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50
2	200.00	197.10	-2.90	-1.45
3	300.00	299.10	-0.90	-0.30
4	400.00	397.50	-2.50	-0.63
AVERAGE (%)				-0.55



Calibrated By: [Signature]
 (Mr. Jirawut Sakarn)
 Field Environmental Scientist (3)

Approved By: [Signature]
 (Mr. Sarayuth Jitranont)
 Assistant General Manager

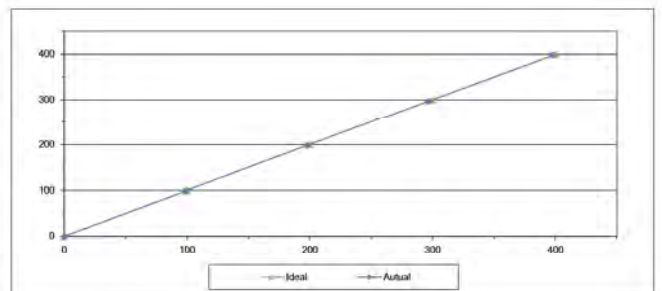
ALS Laboratory Group
 FORM NO.: F-06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-23 Equipment Name: SO2 Analyzer
 Manufacturer: Teledyne API Model: 100E
 Serial No.: 3468 Equipment ID: BKK_FS0772
 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	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.40	-1.60	-1.60
2	200.00	197.70	-2.30	-1.15
3	300.00	296.50	-3.50	-1.17
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				-0.86



Calibrated By: [Signature]
 (Mr. Jirawut Sakarn)
 Field Environmental Scientist (3)

Approved By: [Signature]
 (Mr. Sarayuth Jitranont)
 Assistant General Manager

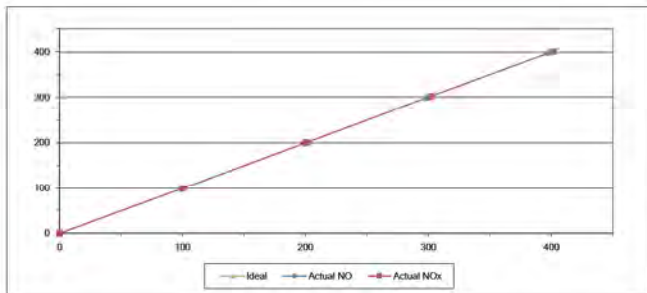
ALS Laboratory Group
 FORM NO.: F-06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	PHD13MC7	Equipment ID	BKK_FS1072
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.40	1.40	0.70	200.70	0.70	0.35
3	300.00	298.30	-1.70	-0.57	302.10	2.10	0.70
4	400.00	396.90	-3.10	-0.78	401.30	1.30	0.33
AVERAGE (%)				-0.35			0.40



Calibrated By

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

Approved By

(Mr.Sarayuth Jittrantont)
Assistant General Manager

ALS Laboratory Group

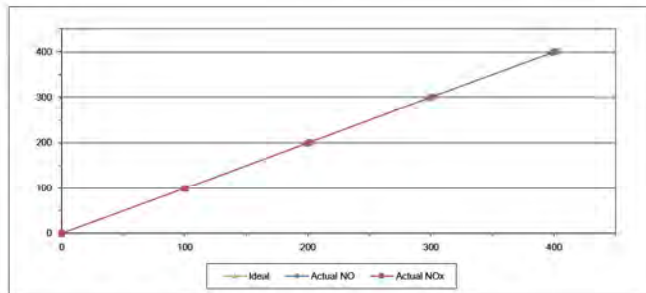
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	30K18RHM	Equipment ID	BKK_FS1086
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	100.20	0.20	0.20
2	200.00	198.30	-1.70	-0.85	201.60	1.60	0.80
3	300.00	298.10	-1.90	-0.63	301.10	1.10	0.37
4	400.00	398.20	-1.80	-0.45	401.60	1.60	0.40
AVERAGE (%)				-0.48			0.37



Calibrated By

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

Approved By

(Mr.Sarayuth Jittrantont)
Assistant General Manager

ALS Laboratory Group

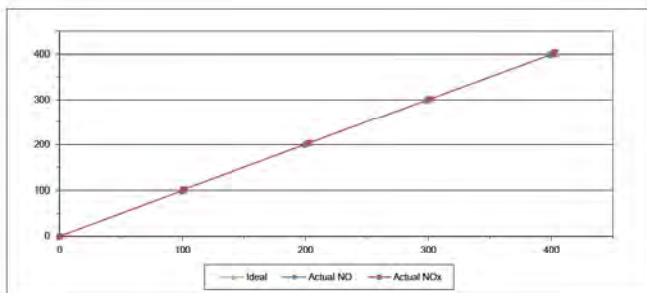
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	200E
Serial No.	4378	Equipment ID	BKK_FS0773
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	101.20	1.20	1.20
2	200.00	199.50	-0.50	-0.25	202.60	2.60	1.30
3	300.00	298.20	-1.80	-0.60	301.30	1.30	0.43
4	400.00	398.70	-1.30	-0.33	402.60	2.60	0.65
AVERAGE (%)				-0.40			0.74



Calibrated By

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

Approved By

(Mr.Sarayuth Jittrantont)
Assistant General Manager

ALS Laboratory Group

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



63/14-15,67/35-36, Soi Petchhasem7,7/1, Petchhasem Rd,
Watthapra, Bangkokyai,Bangkok 10600 Thailand.

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

CERTIFICATE OF CALIBRATION

Certificate No: WD-01112021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novolyne
: Wind direction sensor: Novolyne

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

Serial Number : Data logger: A0377
: Wind direction sensor: -

ID No : Data logger: BKK_FS0917
: Wind direction sensor: -

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.
108 Phadithasem Rd, Phadithasem Puthumong, Suan Luang, Pkoi Suan Luang, Bangkok 10200
Thailand

Environmental Condition:

The measurement was carried out in an ambient temperature of (23±2) °C and relative humidity of (40±10) %.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No: 021086014, Certificate No: PWS04/0525.

Measurement Date : Nov 01, 2021
Issued Date : Nov 01, 2021.

Performed by
☒ Mr. Somkiet Thachak
☐ Miss Orathai Vithayakul



Approved Signature:

Mr. Panyia Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-01112021
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.
Calibration in the range of 0 ~ 360 ° at a calibration interval of 45°.

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty u(°)
1	Clockwise	0/360	350	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	135	0	3.0
5		180	180	183	3	3.0
6		225	225	229	4	3.0
7		270	270	274	4	3.0
8		315	315	320	5	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	135	0	3.0
13		180	180	183	3	3.0
14		225	225	229	4	3.0
15		270	270	274	4	3.0
16		315	315	320	5	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-01112021
Page 1 of 2 pages

Measurement Item	Cup anemometer with data logger.		
Manufacturer	Data logger: Novamex. Cup anemometer: Novamex.		
Model/Type	Data logger: DGL-W5-250L8 Cup anemometer: W5-09P		
Serial Number	Data logger: A5577 Cup anemometer: -		
ID No.	Data logger: BKH_FSD017 Cup anemometer: -		
Customer	ALS laboratory group (Thailand) co., Ltd. 104 Phatthanasarn 40, Phatthanasarn Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand		
Test Conditions	Wind tunnel cross test section area	900	cm ²
	Anemometer frontal area	109	cm ²
	Diameter of mounting pipe	-	mm
	Blockage ratio of test object	0.111	[-]
Test Conditions	Air temperature	25.4	±0.8 °C
	Air pressure	1015.1	±0.4 hPa
	Relative air humidity	47.9	±3.0 %RH
Calibration Procedure	Calibration was carried out based on: ISO/IEC 17025:2017 6.10: 2015 Power Performance Measurements of Electricity Producing Wind Turbines. JIS S 5012:2017 6.10: 2015 Power Performance Measurements of Electricity Producing Wind Turbines. JIS S 5012:2017 6.10: 2015 Power Performance Measurements of Electricity Producing Wind Turbines.		
Traceability	This calibration documents the traceability to national standard, which realizes the unit of measurements according to the International system of units (SI) through National Institute of Metrology (NIM).		
Measurement Date	1 Nov 01, 2021		
Issued Date	1 Nov 01, 2021		
Calibrated by	<input checked="" type="checkbox"/> Mr. Soravit Thachakul <input type="checkbox"/> Miss Oranai Witsakulchai		



Approved Signature:
Mr. Peniya Boonchuan
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-01112021
Page 3 of 2 pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.
Calibration in the range of 0 ~ 15 m/s at a calibration interval of 1 m/s.

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

V _{ref} Reading m/s	V _{act} Reading m/s	Error (m/s)	Uncertainty (m/s)
1.994	1.9	-0.1	2.5
4.002	4.0	0.0	1.2
6.00	6.0	0.0	0.95
8.002	8.0	0.0	0.75
10.01	10.1	0.1	0.63
12.00	12.1	0.1	0.74
13.99	14.1	0.1	0.75
15.01	16.3	0.3	0.80
15.01	16.3	0.3	0.84
13.00	13.1	0.1	0.45
11.01	11.1	0.1	0.57
9.02	9.0	0.0	0.44
7.02	7.0	0.0	0.58
4.992	5.0	0.0	1.2
2.990	2.9	-0.1	1.5
0.995	0.9	-0.1	4.5

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentation

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Wind state	TSSTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 ~ 30 m/s
2	Precision Differential Pressure Meter	Zaglab	DPW2503	Aug 07, 2021	MW-0034-21	5 ~ 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	84459-12	Aug 08, 2021	MW-0035-21	0 ~ 5 m/s
4	Temperature	Zaglab	DS18B19P	March 30, 2021	QI-0077-21	-30 ~ 70°C
5	Relative humidity	Zaglab	DS18H19P	March 30, 2021	PH-0030-21	0 ~ 100 %RH
6	Atmospheric pressure	Zaglab	DS18P19P	March 30, 2021	PR-0030-21	980 ~ 1015 hPa
7	Wind tunnel	CSCM	6010001	-	-	0 ~ 50 m/s

End of certificate of calibration



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

Air speed measurement laboratory
Calibration services department

Jiranatee Associates Co., Ltd.
63/14-15, 67/35-36,
Petchkasem 7/71, Rd Wathapra, Bangkok,
Bangkok 10600 (Thailand)
Tel: +668808012
Mobile: +6688099953
E-mail: jnac.calibration@jiranatee.com
Website: www.jiranatee.com

REVIEW BY:
APPROVED BY:
NEXT CAL. DATE: 5/12/24

Certificate Number
CL-004-68

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	Cup anemometer		
MANUFACTURER	Novamex		
MODEL/TYPE	Sensor: W5-09P Data logger: 110-W5-250L8		
SERIAL NUMBER	Sensor: W5D-004 Data logger: A5445		
ID NUMBER	RYS_20416		
CONDITION AS RECEIVED	Used item		
CUSTOMER	ALS laboratory group (Thailand) co., Ltd. 104 Phatthanasarn 40, Phatthanasarn Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand		
RECEIVED DATE	18 Dec 2022		
MEASUREMENT DATE	18 Dec 2022		
ISSUE DATE	18 Dec 2022		
ENVIRONMENTAL CONDITIONS:	Ambient conditions in the laboratory are as follows:		
Temperature	23.0 ± 1.0	°C	
Relative Humidity	95.0 ± 15.0	%RH	
Atmospheric Pressure	1010.0	hPa	
PLACE OF CALIBRATION	Full-type wind tunnel of Jiranatee Associates Co., Ltd.		
CALIBRATION CONDITIONS	Wind tunnel cross section area ¹	900	cm ²
	Wind direction (frontal area) ²	100	cm ²
	Diameter of mounting pipe ³	-	mm
	Blockage ratio of test object ⁴	0.111	[-]
Preconditioning	24 hours in ambient conditions		
Measurement Condition	The average values during measurement are (24.0) °C, (44.2) %RH and (1010.9) hPa.		
TABULATION OF RESULTS:	The table on next page give the measured values.		

Calibration procedure:
The cup anemometer was calibrated against the standard air velocity transducer (model: W5D-004) one after one with precision differential pressure meter (model: DPW2503) in on-line calibration of full-type wind tunnel (wind speed: 0 ~ 50 m/s) test section area. The W5D-004 based on IEC 61400-12-1. Wind energy conversion systems - Part 12-1: Power performance measurements of electricity producing wind turbines. Nov 2017 was used as 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 NIM (National Institute of Metrology 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 signature:
Mr. Peniya Boonchuan
Calibration Department Manager

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Certificate Number
CL-004-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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 9.5 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 as calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.997	23.88	23.95	0.9	-0.1	0.17
2.034	23.98	23.95	1.9	-0.2	0.17
3.060	24.00	23.95	3.0	-0.3	0.18
4.125	23.94	23.95	4.0	-0.2	0.18
5.01	24.04	23.95	4.9	-0.1	0.25
5.99	24.10	23.95	5.9	-0.1	0.19
7.00	23.74	23.95	6.9	-0.1	0.20
8.97	24.08	23.95	8.0	-0.1	0.20
9.09	23.80	23.95	9.0	-0.1	0.20
10.09	23.50	23.95	10.0	-0.1	0.22
11.84	21.95	23.95	11.1	-0.1	0.27
12.13	23.66	23.95	11.9	-0.2	0.24
13.20	21.82	23.95	13.2	0.0	0.27
14.20	23.16	23.95	14.9	0.0	0.25
15.25	23.74	23.95	15.3	0.0	0.29
16.31	23.64	23.95	16.3	0.0	0.26

Remark:
¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
² Velocity of standard
³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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 counter-clockwise 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 ¹ _{ref} Degree (°)	D ² _{UUC} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	42	-3	0.68
	90.000	87	-3	0.74
5.01	135.000	133	-2	0.74
	180.000	181	1	0.74
	225.000	229	3	0.76
	270.000	274	4	0.74
	315.000	319	4	0.68

Remark:
¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
² Direction of standard
³ Direction of Unit Under Calibration



Certificate Number
CL-004-66

J NAC
 JIRANATEE ASSOCIATES CO., LTD.
 Jiranatee Associates Co., Ltd.
 63/14-15, 87/30-36
 Poonnasan 7/71, Rajawithayalai, Bangkok
 Bangkok 10200 (Thailand)
 Tel: +66(0)800812
 Mobile: +66(0)8299953
 E-mail: jnac@jiranatee.com, jnac@jiranatee.co.th
 Web site: www.jiranatee.com

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

Air speed measurement laboratory
 Calibration services department

Certificate Number
CL-004-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory area is as follows:

Temperature:

Relative Humidity:

Atmospheric Pressure:

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

By Mr. Sorawat Thicholad

By Miss Jiraporn Lertsomphol



Approved signature:

Mr. Parinya Booncharoen
 Calibration Department Manager

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

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J NAC
 JIRANATEE ASSOCIATES CO., LTD.
 Jiranatee Associates Co., Ltd.
 63/14-15, 87/30-36
 Poonnasan 7/71, Rajawithayalai, Bangkok
 Bangkok 10200 (Thailand)
 Tel: +66(0)800812
 Mobile: +66(0)8299953
 E-mail: jnac@jiranatee.com, jnac@jiranatee.co.th
 Web site: www.jiranatee.com

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

Pressure measurement laboratory
 Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. : CL-002-66

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument

Model

Serial No.

Certificate No.

Date Date

1. Calibration effort for calibration sequence A

2. The UUC was installed in vertical orientation above reference standard instrument and center of UUC¹ was used as the reference level.

3. Calibration conditions:

4. Condition

Pressure transmitting medium

ρ (20°C, 1 bar)

μ_{visc}

T_{amb}

P_{ref}

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

Calibration procedure:

The pressure calibration was done by in-house calibration method as per ISO/IEC 17025 according to comparison method with Digital pressure calibrator based on DKD P 6-1

Traceability:

The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) which complies with the requirements of ISO/IEC 17025:2017, ANSI/NCSL Z540-1 via Certificate number: NIP-0205-22

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



Approved signature:

Mr. Parinya Booncharoen
 Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Calibration No.: RH-01012023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novelty
Model/Type: 110-WS-250L-D
Serial Number: A5445
ID No.: RYG_F80486
Customer: ALS laboratory group (Thailand) Co. Ltd.
104 Phatthakan 40, Phatthakan Rd., Khwaeng Suan Luang, Phet Suan Luang, Bangkok
10250 Thailand.

CERTIFICATE OF CALIBRATION

Certificate No.: CL-002-66

Page 2 of 2 Pages

MEASUREMENT RESULTS: ☒ Without adjustment ☐ With adjustment
CALIBRATION IN THE RANGE OF: 950 - 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.17	950.9	0.7	0.94
970.13	970.6	0.5	0.64
990.08	990.4	0.3	0.53
1010.10	1010.3	0.2	0.42
1030.10	1030.1	0.0	0.37
1050.09	1049.9	-0.1	0.41

Note: UUC* Unit Under Calibration
To convert the result in report unit to Pa should be multiply by 100



Environmental Condition:
The measurement was carried out in an ambient temperature of 25±3°C, and relative humidity of 60±15%.

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

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

Measurement Date: Jan 05, 2023
Issued Date: Jan 09, 2023

Measurement Results:
This equipment was connected with indoor air quality probe unit: Displayed: RH% on display; Model: HMP60; Serial number: R1131113.

Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below:

Determined (%RH)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	19.97	19.4	-0.5	0.62
50	50.29	49.1	-1.2	0.57
80	80.32	78.9	-1.4	0.57

Performed by:
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No.: CL-001-66
Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor
Manufacturer: Novelty
Model: 110 WS 250L-D
Serial No.: A5445
ID No.: RYG_F80436

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

Received date: 28 Dec 2022
Calibration date: 05 Jan 2023
Issue date: 09 Jan 2023

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-00, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A Mk
II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (86±15)%

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

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: CR-0022-
22

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Certificate No.: CL-001-66
Page 2 of 2

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

Function:
This equipment was connected with temperature sensor Model: HMP60 S/R R1131113.
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.061	20.0	-0.1	0.099
60	25.057	25.0	-0.1	0.099
60	30.045	29.9	-0.1	0.16
60	35.043	34.9	-0.1	0.099
60	40.039	39.9	-0.1	0.099

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



MEASUREMENT RESULTS¹

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 (type: B455/32) and pitot tube with precision differential pressure meter model: BMM520 in precise trip position of Effel type wind tunnel (with 500 mm² cross test section area. The B455/32 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.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
0.589	23.56	23.80	0.9	-0.3	0.15
2.015	23.72	23.80	1.9	-0.2	0.16
3.058	23.58	23.80	3.0	-0.1	0.32
4.139	23.66	23.80	4.0	-0.1	0.20
5.011	23.90	23.80	5.0	0.0	0.30
6.03	23.58	23.80	6.0	0.0	0.15
7.04	23.80	23.90	7.0	-0.1	0.22
8.17	23.84	23.80	8.2	0.0	0.34
9.10	23.90	23.80	9.2	0.1	0.32
10.09	23.90	23.80	10.0	-0.3	0.27
11.14	23.90	23.80	11.1	0.0	0.23
12.14	24.00	23.80	12.3	0.0	0.34
13.20	23.90	23.80	13.2	0.0	0.32
14.27	23.90	23.80	14.3	0.0	0.35
15.25	23.92	23.80	15.3	0.0	0.34
16.30	23.92	23.80	16.3	0.0	0.29

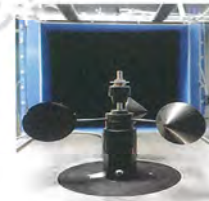
Remarks:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

² Velocity of standard.

³ Velocity of Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



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



MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

: Cup anemometer

: Novalyse

: Sensor: WS-02F

: Data logger: 110-WS-250L-D

: Sensor: WSD-002

: Data logger: AS443

: BMM_520/25

: Used Item

: AIS laboratory group (Thailand) Co., Ltd.

: 104 Phrahitthikan 40, Phrahitthikan Rd, Khwaeng Suan Luang,

: Khut Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer (type: B455/32) and pitot tube with precision differential pressure meter model: BMM520 in precise trip position of Effel type wind tunnel (with 500 mm² cross test section area. The B455/32 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 international standards, and to realization of the International system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate Number: MMV-0257-21 and MMV-0266-22.

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

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 0.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.9 hPa

PLACE OF CALIBRATION

: Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area¹: 900 cm²

: Win direction frontal area²: 100 cm²

: Diameter of mounting pipe³: - mm

: Blockage ratio of test object⁴: 0.111 [-]

Preconditioning

Measurement Condition

: 24 hours at ambient conditions.

: The average values during measurement are (23.6) °C, (65.4) %RH and (1019.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Soravit Thirachai

☐ Miss Jiraporn Jirapornphol



Approved signature:

Stefan
Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Inside cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio: A_o/A_t

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

MEASUREMENT RESULTS¹

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 counter-clockwise 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 _{ref} Degree (°)	D _{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	0.000	0	0	0.58
	45.000	42	-3	0.74
	90.000	88	-2	0.68
	135.000	133	-2	0.74
	180.001	181	1	0.74
	225.000	227	2	0.74
	270.000	273	3	0.74
	315.000	318	3	0.74

Remarks:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

² Direction of standard

³ Direction of Unit Under Calibration



End of Certificate of Calibration

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

: Wind Direction sensor

: Novalyse

: Sensor: WS-03

: Data logger: 110-WS-250L-D

: Sensor: WSD-002

: Data logger: AS443

: BMM_520/25

: Used Item

: AIS laboratory group (Thailand) Co., Ltd.

: 104 Phrahitthikan 40, Phrahitthikan Rd, Khwaeng Suan Luang,

: Khut Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder, model: B455/32 and pitot tube with precision differential pressure meter model: BMM520 in precise trip position of Effel type wind tunnel (with 500 mm² cross test section area. The B455/32 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 international standards, and to realization of the International system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate Number: MMV-0257-21 and MMV-0266-22.

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

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 0.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.9 hPa

PLACE OF CALIBRATION

: Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area¹: 900 cm²

: Win direction frontal area²: 120 cm²

: Diameter of mounting pipe³: - mm

: Blockage ratio of test object⁴: 0.143 [-]

Preconditioning

Measurement Condition

: 24 hours at ambient conditions.

: The average values during measurement are (24.0) °C, (53.7) %RH and (1015.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Soravit Thirachai

☐ Miss Jiraporn Jirapornphol



Approved signature:

Stefan
Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Inside cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio: A_o/A_t

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

CERTIFICATE OF CALIBRATION

Certificate No. : CC-001-06

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Navamix
MODEL/TYPE : 110-W5-25AP
SERIAL NUMBER : AS843
ID NUMBER : BKK_130975
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suai Luang, Khet Suai Luang,
Bangkok 10250 Thailand.
RECEIVED DATE : 28 Dec 2022
MEASUREMENT DATE : 06 Jan 2023
ISSUE DATE : 09 Jan 2023

Calibration procedure:
The pressure calibration was done by in-house calibration method as per CL-003 according to comparison method with Digital pressure calibrator based on OX-D-1.

Traceability:
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) which complies with the requirements of ISO/IEC 17025:2017, ANSI/NCSL Z540-1 via Certificate number: MP-0205-22.
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor, providing a level of confidence of approximately 95%.

CONDITION OF THIS RESULT OF CALIBRATION:

- Reference Standard Instrument:
Instrument Model Serial No. Certificate No. Due Date
Absolute Pressure Transducer CPG2300 4100126P MP-0205-22 02 Dec 2023
- Calibration effort for calibration sequence A
- The UUC* was initiated in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
- Calibration conditions:
a. Condition : ☒ Normal ☐ Abnormal
Pressure transmitting medium : Air
 ρ_{air} (20°C, 1 bar) : 1.19 kg/m³
 H_{amb} : 55415%
 T_{amb} : 123.83 °C
 P_{amb} : (1010±10) mbar
- The certificate is valid only to the item calibrated on date and place of calibration.

Calibrated by:
☒ Mr. Soravit Thachulad
☐ Ms. Jitraporn Lertsomphol



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Certificate No. : CL-001-06

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 – 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.16	950.9	0.7	0.55
970.12	970.6	0.5	0.77
990.09	990.4	0.3	0.33
1010.10	1010.1	0.0	0.37
1030.11	1029.8	-0.3	0.48
1050.12	1049.7	0.4	0.61

Note: UUC* Unit Under Calibration
To convert the result in report unit to Pa should be multiply by 100



SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/11 Sinitthorn Rd., Bangbunru, Bangplud Bangkok 10100 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACC22043
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178118
ID No. : BKK_FS0631

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchurai)

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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC22043
Job No. : VC66AC0016
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.
The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04-0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03-0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL_BP_05-0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	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 :

- National Institute of Metrology (Thailand).
- Thailand Institute of Scientific and Technological Research (TISTR).

Cert. No. : ACC22043
Job No. : VC66AC0016
Pages : 3 of 3451-451/1 Sidthorn Rd., Bangbunru, Bangkok 10700 THAILAND.
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22112
Pages : 1 of 8

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchurai

Cert. No. : ACL22112
Job No. : VC65AC0059
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchurai

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52/ Microphone UC-59 / Preamplifier NH-25
Serial No.: 00764923 / 09851 / 65049
ID No.: BKK_FS0135

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

REVIEW BY : *Nathakorn P.*
APPROVED BY : *T. Petchurai*
NEXT CAL DATE : 24/5/23

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.

QF-TS12-04-04-020664

Cert. No. : ACL22112
Job No. : VC65AC0059
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	✓	-	0.3	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

QF-TS12-04-04-020664

T. Petchurai

Cert. No. : ACL22112
Job No. : VC65AC0059
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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	16.3
Flat	22.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.8	0.9	0.9	+ 1.5, - 2.5

QF-TS12-04-04-020664

T. Reth.

Cert. No. : ACL22112
Job No. : VC65AC0059
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	±1.0
125	0.0	0.1	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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
1 eq	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	± 0.1

QF-TS12-04-04-020664

T. Reth.

Cert. No. : ACL22112
Job No. : VC65AC0059
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	29.9	-0.1	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.9	-0.1	±0.8

QF-TS12-04-04-020664

T. Reth.

Cert. No. : ACL22112
Job No. : VC65AC0059
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	±0.8

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±2.0

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	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

QF-TS12-04-04-020664

T. Reth.

Continuation of Calibration Certificate

Cert. No. : ACL22112
Job No. : VC65AC0059
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.5	-0.2	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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 weightings with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchur

451-451/1 Sirinthern Rd., Bangbunru, Bangkok 10700 THAILAND.
Tel: 0-2435-8800 Fax: 0-2431-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22108
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52/ Microphone UC-59 / Preamp NH-25
Serial No.: 00764918 / 09845 / 65044
ID No.: BKK_FS0131

Condition As Found : GOOD

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

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchur
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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	✓	-	0.3	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

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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)	94.0	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	15.6
Flat	21.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.6	0.7	0.7	+ 1.5, - 2.5

QF-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	30.0	0.0	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	27.0	0.0	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.9	-0.1	±0.8

QF-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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	±1.0
125	0.1	0.1	0.1	±1.0
250	0.0	0.1	0.0	±1.0
500	0.0	0.1	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

QF-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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	±0.8

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	0.0	±2.0

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	±1.0
Negative half cycle	135.4	135.1	-0.3	±1.0

QF-TS12-04-04-020664

T. Retch.

Continuation of Calibration Certificate

Cert. No. : ACL22108
Job No. : VC65AC0059
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	89.5	0.0	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

QF-TS12-04-04-020664

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



Cert. No. : ACL22107
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52/ Microphone UC-59 / Preamplifier NH-25
Serial No. : 00764916 / 09843 / 65042
ID No. : BKK_FS0130

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 17 MAY 2022
Calibration Date : 24-27 MAY 2022
Date of Issue : 30 MAY 2022

REVIEW BY : *Nathakorn P*
APPROVED BY : *T. Petchur*
NEXT CAL. DATE : 24/5/23

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchur*
(Thanakul Petchur)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22107
Job No. : VC65AC0059
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP, 04-0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP, 03-0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP, 05-0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	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).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22107
Job No. : VC65AC0059
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	✓	-	0.3	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

QF-TS12-04-04-020664

Cert. No. : ACL22107
Job No. : VC65AC0059
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)	94.0	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	15.7
Flat	21.3

3. Acoustical signal tests of frequency weightings

Meter free field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	-0.6	0.6	0.6	+ 1.5, - 2.5

QF-TS12-04-04-020664

T. Ratan

Cert. No. : ACL22107
Job No. : VC65AC0059
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	-0.1	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	-0.1	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

QF-TS12-04-04-020664

T. Ratan

Cert. No. : ACL22107
Job No. : VC65AC0059
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.1	0.1	±0.8
84.0	84.1	0.1	±0.8
79.0	79.0	0.0	±0.8
74.0	74.1	0.1	±0.8
69.0	69.1	0.1	±0.8
64.0	64.0	0.0	±0.8
59.0	59.1	0.1	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.1	0.1	±0.8
30.0	30.0	0.0	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	26.0	0.0	±0.8
25.0	25.0	0.0	±0.8

QF-TS12-04-04-020664

T. Ratan

Cert. No. : ACL22107
Job No. : VC65AC0059
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	±0.8

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±2.0

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	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

QF-TS12-04-04-020664

T. Ratan

Continuation of Calibration Certificate

Cert. No. : ACL22107
Job No. : VC65AC0059
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	±0.1

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

451-451/1 Sirinthorn Rd, Bangbunmu, Bangkok 10700 THAILAND.
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.comCert. No. : ACL22113
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52/ Microphone UC-59 / Preamplifier NH-25
Serial No. : 00764924 / 09852 / 65050
ID No. : BKK_FS0136

Condition As Found : GOOD

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

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

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

REVIEW BY : *Nathakorn P.*
APPROVED BY : *Th. Petchur*
NEXT CAL. DATE : 24/5/23

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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22113
Job No. : VC65AC0059
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22113
Job No. : VC65AC0059
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	✓	-	0.3	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

QF-TS12-04-04-020664

T. Petchur

Cert. No. : ACL22113
Job No. : VC65AC0059
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.7

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	16.7
Flat	22.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.2	0.3	0.3	+ 1.5, - 2.5

QF-TS12-04-04-020664

T. Petch.

Cert. No. : ACL22113
Job No. : VC65AC0059
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	-0.1	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

QF-TS12-04-04-020664

T. Petch.

Cert. No. : ACL22113
Job No. : VC65AC0059
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	53.9	-0.1	±0.8
49.0	49.0	0.0	±0.8
44.0	43.9	-0.1	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.8	-0.2	±0.8

QF-TS12-04-04-020664

T. Petch.

Cert. No. : ACL22113
Job No. : VC65AC0059
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	±0.8

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	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 _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.5	-0.9	±2.0

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	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22113
Job No. : VC65AC0059
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	89.7	0.1	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_03/0265	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).

QF-TS12-04-04-020664

T. Petchur

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



Cert. No. : ACL22110
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52/ Microphone UC-59 / Preamplifier NH-25
Serial No. : 00764920 / 09848/ 98925
ID No. : BKK_FS0133

Condition As Found : GOOD

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

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

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

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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
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	✓	-	0.3	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

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Measured value (dB)
A - weight	12.8
C - weight	17.8
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.9	1.0	1.0	+ 1.5, - 2.5

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
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	0.0	-0.1	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.9	-0.1	±0.8

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
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	±0.8

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.7	-0.7	±2.0

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	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22110
Job No. : VC65AC0059
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	89.5	0.0	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22111
Job No. : VC65AC0059
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 test results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

451-451/1 Sirdithorn Rd.,Bangbunnu, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8860 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22111
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52/ Microphone UC-59 / Preamplifier NH-25
Serial No. : 00764922 / 09850 / 65048
ID No. : BKK_F80134

Condition As Found : GOOD

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

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

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

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>T. Petchurui</i>
NEXT CAL DATE	24/5/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurui
(Thanakul Petchurui)

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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22111
Job No. : VC65AC0059
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	✓	-	0.3	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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

Cert. No. : ACL22111
Job No. : VC65AC0059
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	16.5
Flat	22.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	± 1.0
1000	0.1	0.1	0.1	± 0.7
8000	0.6	0.7	0.7	+ 1.5, - 2.5

QF-TS12-04-04-020664

T. Petch.

Cert. No. : ACL22111
Job No. : VC65AC0059
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	0.0	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

QF-TS12-04-04-020664

T. Petch.

Cert. No. : ACL22111
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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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.8	-0.2	±0.8

QF-TS12-04-04-020664

T. Petch.

Cert. No. : ACL22111
Job No. : VC65AC0059
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	±0.8

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±2.0

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	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22111
Job No. : VC65AC0059
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	±0.1

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

End of Calibration Certificate

T. R. A.



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Cyanide	Discrete analyzer	BKK_EN0037	5-Jan-23	5-Jan-24	12
Water Lab	Cyanide	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	pH at 25 °C	pH meter	BKK_EN0072	12-Sep-22	12-Mar-24	18
Water Lab	Color (at Original pH)	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Water Lab	Color (at pH 7.0)	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Water Lab	Dissolved Oxygen	Burette	BKK_EN0171	30-Aug-22	1-Mar-24	18
Water Lab	Dissolved Oxygen	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0002	8-Feb-23	8-Feb-24	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	31-Jan-22	1-Aug-23	18
Water Lab	Total Kjeldahl Nitrogen	Digestion Unit	BKK_EN0366	17-May-23	17-May-24	12
Water Lab	Total Kjeldahl Nitrogen	Discrete analyzer	BKK_EN0037	5-Jan-23	5-Jan-24	12
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BKK_EN0002	8-Feb-23	8-Feb-24	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0273	29-Nov-22	29-May-24	18
Water Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	BKK_EN0002	8-Feb-23	8-Feb-24	12
Water Lab	Total Dissolved Solids 180°C	Oven	BKK_EN0273	29-Nov-22	29-May-24	18
Water Lab	BOD (5 days at 20°C)	DO Meter	BKK_EN0017	24-May-22	24-Nov-23	18
Water Lab	BOD (5 days at 20°C)	Incubator	BKK_EN0305	5-Apr-23	5-Apr-24	18
Water Lab	COD	Hot Block	BKK_EN0222	1-Mar-23	1-Mar-24	12
Water Lab	COD	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
Water Lab	Temperature	pH meter	BKK_LG0044	4-Oct-22	4-Oct-23	12
Water Lab	Temperature	pH meter	BKK_LG0030	17-Nov-22	17-Nov-23	12
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	16-Sep-22	16-Sep-23	12
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	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	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	DUO-CVAFS / CVAAS	BKK_EL0023	24-May-23	24-May-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



บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด
DOUBLE S DIAGNOSTICS CO., LTD.

4 ซอยอุดมสุข 14 แขวงบางนา เขตบางนา กรุงเทพฯ 10260 โทรศัพท์: (02) 747-7000 โทรสาร: (02) 747-7008
4 Soi Udomsuk 14, Bangna, Bangkok 10260 Tel: (02) 747-7009 Fax: (02) 747-7008

Maintenance Plan YEAR : 2022

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รวม	✓	✓										

Periodical maintenance check list for Konelab

	6M	12M	Note
1.Diluent-wash tubing change	✓	✓	
2.ISE tubing change	✓	✓	none
3.Syringe check/change			
4.Dispensing check/ change			
5.Waste tubing change when necessary			
6.Lamp check/change	✓		
7.Mixer paddle/paddle change(not Konelab20)			
8.ISE needles check/change			
9.Pump tubing check/ change	✓		
10.Broken/worn out part check /change			
11.Peristaltic pump check /cleaning/ lubrication	✓		
12.Heating check			
13.Cooling check			
14.Dispenser mechanic check/adjustment	✓		
15.Cuvette transfer mechanic check/adjustment	✓		
16.Dispenser movement check/adjustment	✓		
17.Sample/reagent register check/adjustment	✓		
18.Dispensing tubing tightness check	✓		
19.Photometer and optics cleaning/check/adjustment	✓		
20.Workstation PC cleaning if necessary	✓		
21.Mechanic cleaning/lubrication	✓		
22.Instrument cleaning if necessary	✓		
23.Complete analyzer testing with waterblank/QC or sample	✓		
24.Test parameters/Adjustment/config. Save to USB key	✓		
25.UPS Test	✓		

Place: ALS Laboratory Instrument: K20 Aquakem 350
Date/Time: 05-01-22 Serial no: 09981
Service done by: K20 350 Install date:
Signature of customer: K20 350 Date/Time:



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, 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

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

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

FM-L14 117/01-02-64



Metrological Center

SCI ECO Services Company Limited

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



Certificate No. T221644

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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: [Signature]



Metrological Center

SCI ECO Services Company Limited

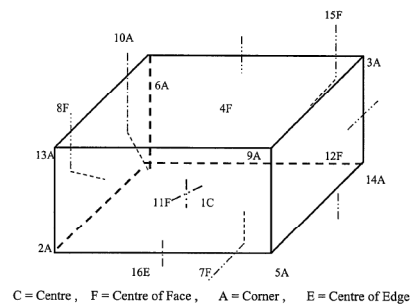
33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.



Certificate No. T221644

Page 3 of 4

Calibration Report



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: [Signature]

Certificate No. T221644

Page 4 of 4

Calibration Report

Measurement Results:

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

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

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

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

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



FM-L15 I17/15-05-63

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-7000-27 FAX: 0-2716-9484Cert.No.: 22CH1222
Page: 1 of 2


Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven Compact S220
Serial No. : B520948426
ID No. : BKK_EN0072
Condition As-Received: Used Item
Received Date : 09 September 2022
Calibration Date : 12 September 2022
Reference : 2209-0312DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanasak, Khet Suan Luang,
Bangkok 10250 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)

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	12/03/24

Calibrated by : Warakorn Lemgagrakul

Approved by : 
Approved Signatory() Malee Butkruea
() Saithip Meangmai
() Warakorn Lemgagrakul

Issue Date : 15 September 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.Cert. No.: 22CH1222
Page: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	823320	20 June 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.008	CPA chem	823323	20 June 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of pH measurement (± mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B520948426	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	0.0	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor <i>k</i>
pH Electrode S/N.: PCE-88-EX1U01	4.008	3.999	153.9	0.0055	2.09
	6.985	7.017	-13.7	0.0084	2.00
	10.008	9.996	-179.0	0.0078	2.06

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 %.

-000-



Certificate of Calibration

Equipment: SPECTROPHOTOMETER
Model: DR6000
Serial No. (or ID): 1627845 (RYG_EN0037)
Manufacturer: HACH
Condition: In Condition

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

Environment Condition: Temperature 23.1 °C ±
Humidity 65.4 %RH ±

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

Calibration By: Mr. Chattaphon 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. Chattaphon Foithong)
Person in charge(Mr. Thalemkat Pongnam)
Authorized signatoryThis 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.DKSH Technology Limited
2533 หมู่ 5 ตำบลบ้านใหม่ อำเภอเมืองจันทบุรี จังหวัดจันทบุรี 12000
2533 Salaemai Road, Bangnai, Prachinburi, Bangkok 12000
Phone: +66 2630 7000 Email: info.saleration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - in Asia and Beyond.

CALFM-C06-15: 20 Jul 2022

a 1126274

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of 81d 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	0.716	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
835 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.8847	0.885	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 หมู่ 5 ตำบลบางนา อำเภอบางนา กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prathung, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

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CALFM-C06-13: 20 Jul 2022

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 (%)	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
Standard Wavelength (nm)		268.60	268.63	1.39
UUC: Wavelength (nm)		268.2	268.1	2.00
Std Absorbance (A)		0.4810	0.3176	
Absorbance (A)		0.373	0.268	

* Calibration Marked * Not TISI Accredited * In this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 หมู่ 5 ตำบลบางนา อำเภอบางนา กรุงเทพมหานคร 10260
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CALFM-C06-13: 20 Jul 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (วัน)		รายการตรวจสอบ	ตรวจสอบ (ผู้)		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 Switch)	<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. ควบคุมเลือกความยาวคลื่น (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 nm 656.1 nm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แสงอัลตราไวโอเลต (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แสงที่มองเห็นแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่หลอดตัวอย่าง (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. กระบวนการล้างตัวอย่าง (>= 2.5 ไม่นาที 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic Dilutor			
<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"/>	

เซ็นเซอร์อุณหภูมิ:

Mr. Chattaphon Folthong
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 หมู่ 5 ตำบลบางนา อำเภอบางนา กรุงเทพมหานคร 10260
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CAL-FM-R31-09: 20 Jul 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-27 FAX: 0-2719-9484

Cert.No.: 22CG3154
Page.: 1 of 2

Certificate of Calibration

Equipment :	Burette
Capacity :	50 mL
Serial No. :	-
ID. No. :	BKK_EN0171
Manufacturer :	Witeg
Made in :	Germany
Submitted by :	ALS Laboratory Group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd. Khwaeng Phatthanakan, Khet Suan Luang Bangkok 10250 Thailand
Ambient Temperature :	(20 ± 2.5) °C
Relative Humidity :	(50 ± 10) %
Barometric Pressure :	759 mmHg
Calibration Procedure :	ASTM E 542 - 01
Calibrated by :	Panward Pramklam
Approved by :	 Approved Signatory
() Pornthippa Tameyakul	
() Malee Butkruea	
() Ponpan Paipim	
() Srisuda Khamtha	
Issue Date :	31 August 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 0044607



Equipment : Burette
Received Date : 26 August 2022
Condition As-Received : Used Item
Calibration Date : 30 August 2022
Reference : 2208-0918DSC-2

Cert.No.: 22CG3154
Page: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

Instruments	Model	Serial No.	ID No.	Certificate No.	Traceability	Due date
1) Balance	AE200S	N03679	140RC001	21MM429	NIMT	22 Sep 2022
2) Thermo-Hygrograph	THDX-CE	00016540	140EC001	22H1243	NIST,NIMT	09 June 2023
3) Thermometer	-	1594592	140EC010	221181	NIMT	10 Feb 2023

This certification is traceable to SI Unit

2. The certificate is valid only to the item calibrated on date and place of calibration.
3. True value is converted to true volume at the standard temperature of 20 °C

Calibration result :

Nominal capacity (mL)	Reading (mL)	Uncertainty (± mL)	k Factor
50	49.9959	0.010	2.00

Remark mL = cm³

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 %.

-o-o-

PD

a 1123908

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-5 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 26207042
ID No. : BKK_EN0002
Manufacturer : Sartorius

Certificate No. : 23BCI0072
Issued Date : Monday, February 13, 2023
Reference No. : 203245
Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability

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

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

Eccentricity (Off-center loading error)

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

Nominal value :	50	g
Tolerance	0.0004	g
		Difference
1		-
2		-0.0001
3		0.0000
4		0.0001
5		0.0000
6		-

Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
2	2.0000	2.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	199.9999	-0.0001	0.00030

End of Report

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-5, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

NSC-TS1-TS 17025
CALIBRATION 0426

REVIEW BY : Sinlut P.
APPROVED BY : K.L. AL
NEXT CAL. DATE : 8/2/24

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 26207042
ID No. : BKK_EN0002
Manufacturer : Sartorius

Certificate No. : 23BCI0072
Issued Date : Monday, February 13, 2023
Reference No. : 203245
Page No. : 1 of 2

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250.

Calibrated Place : Balance Room

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

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

Metrological data :

Capacity : 220 g Readability : 0.0001 g

Ambients Conditions:

Temperature : 23.2 °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 expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

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

This certificate relate and apply this equipment only.

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

Mr. Chonchai Inthana(Technical Manager)

SOP FM 33 03 February 2022



Metrological Center

SCI ECO Services Company Limited

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

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

Bangkok Tel : +008 9205 0051 , +008 9247 2300

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

Certificate No. T220139

Page 1 of 3

Certificate of Calibration

Equipment : Liquid Bath (Water)

Manufacturer : MEMMERT

Model : WNB29

Serial No. : L611.0135

Customer Code : BKK_EN0148

ID No. : T6455A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250

Customer Location : ORGANIC PREPARATION LAB

Date of Receipt : 26 January 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By : Sujar Naknakred (Site Calibration Manager)

Date of Issue : 08 FEB 2022

REVIEW BY : Sinlut P.
APPROVED BY : K.L. AL
NEXT CAL. DATE : 1/8/23

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. T220139

Page 2 of 3

Calibration Report

Equipment : Liquid Bath (Water)
Date of Calibration : 31 January 2022
Environment : Temperature : 22.4-23.9 °C
Line Voltage : 221.4-225.4 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

- This equipment was calibrated by insert five resistance thermometer detectors into its water bath , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T36 (based on ASTM E715-801 (Reapproved 2001)). All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
- Reference Standard Instrument :
Instrument Model Instrument No. Certificate No. Due Date
RTD 100 QHM M34 (CH1-CH5) T210115 2 February 2022
DATA LOGGER 34970A T47 T210115 2 February 2022
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)
- Condition of calibrated item : good
Equipment Description :
Time Constant 1 Hour Minute At 60 °C
5. Adjustment :
(X) without adjustment () after adjustment

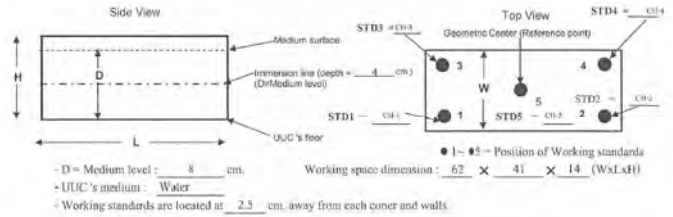
Approved By:

FM-L15 117/15-05-63

Certificate No. T220139

Page 3 of 3

Calibration Report



Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)				
	CH-1	CH-2	CH-3	CH-4	CH-5
60	59.95	60.04	60.12	60.01	59.89
85	85.17	84.89	85.34	84.78	84.93
95	93.46	93.14	93.81	93.05	93.28

Liquid Bath (Water)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (± °C)	Uniformity (± °C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max				
61.0	60.9	61	0.10	0.19	0.25	2.09
86.0	85.9	86.1	0.12	0.39	0.32	2.06
95.0	94.8	95.1	0.14	0.51	0.38	2.11

* 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:

FM-L15 117/15-05-63

Certificate No. T230902

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 : 10 May 2023
Calibrated By : Sujjar Naknakred (Site Calibration Manager)
Approved By : / Boonchai Suriyawong (Site Calibration Manager)
Date of Issue : 29 MAY 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.

FM-L12 109/30-05-57

Certificate No. T230902

Page 2 of 5

Calibration Report

Equipment : Digestion Unit
Date of Calibration : 17 May 2023
Environment : Temperature : 23.9 - 26.3 °C
Line Voltage : 221.8 - 225.9 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

- 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.
- Reference Standard Instrument :
Instrument Model Instrument No. Certificate No. Due Date
TC Type S M20A1-(CH17-CH20) T230547 18 April 2024
DATA LOGGER 34970A T149 T230547 18 April 2024
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)
- Condition of calibrated item : good
Equipment Description :
Time Constant 1 Hour 54 Minute At 380 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment :
(X) without adjustment () after adjustment

Approved By:

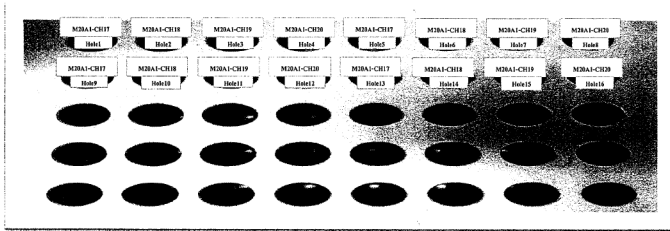
FM-L13 108/30-05-57



Certificate No. T230902

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
380.0	380.0	379.4 - 380.7		MDIAI-CH17	MDIAI-CH18	MDIAI-CH19	MDIAI-CH20	MDIAI-CH21	MDIAI-CH22	MDIAI-CH23	MDIAI-CH24
			Max °C	377.5	379.0	379.2	380.2	377.5	379.5	380.7	380.1
			Min °C	376.8	378.6	378.9	379.9	377.0	379.0	380.2	379.6
			Average °C	377.0	378.8	379.1	380.0	377.3	379.2	380.4	379.9
			Stability ± °C	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	Hole9	Hole10	Hole11	Hole12	Hole13	Hole14	Hole15	Hole16
380.0	380.0	379.4 - 380.7		MDIAI-CH17	MDIAI-CH18	MDIAI-CH19	MDIAI-CH20	MDIAI-CH21	MDIAI-CH22	MDIAI-CH23	MDIAI-CH24
			Max °C	377.1	378.9	379.7	379.9	379.3	379.6	379.5	377.4
			Min °C	376.7	378.5	379.3	379.5	378.9	379.1	379.0	377.0
			Average °C	376.9	378.7	379.5	379.7	379.1	379.4	379.3	377.2
			Stability ± °C	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2

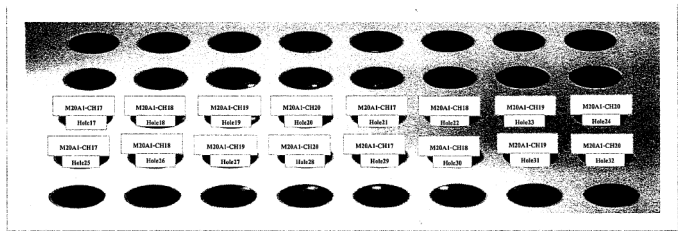
Approved By.

FM-L13 108/30-05-57

Certificate No. T230902

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
380.0	380.0	379.4 - 380.7		MDIAI-CH17	MDIAI-CH18	MDIAI-CH19	MDIAI-CH20	MDIAI-CH21	MDIAI-CH22	MDIAI-CH23	MDIAI-CH24
			Max °C	378.4	380.1	380.1	380.0	379.1	379.8	379.6	377.8
			Min °C	377.8	379.6	379.7	379.3	378.6	379.2	379.2	377.3
			Average °C	378.1	379.9	379.9	379.7	378.9	379.5	379.4	377.5
			Stability ± °C	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	Hole25	Hole26	Hole27	Hole28	Hole29	Hole30	Hole31	Hole32
380.0	380.0	379.4 - 380.7		MDIAI-CH17	MDIAI-CH18	MDIAI-CH19	MDIAI-CH20	MDIAI-CH21	MDIAI-CH22	MDIAI-CH23	MDIAI-CH24
			Max °C	377.9	379.4	380.1	380.1	379.3	379.6	378.9	377.3
			Min °C	377.4	378.9	379.7	379.7	378.8	378.9	378.4	376.7
			Average °C	377.7	379.2	379.9	379.9	379.3	379.3	378.6	377.0
			Stability ± °C	0.3	0.3	0.2	0.2	0.3	0.4	0.3	0.3

Approved By.

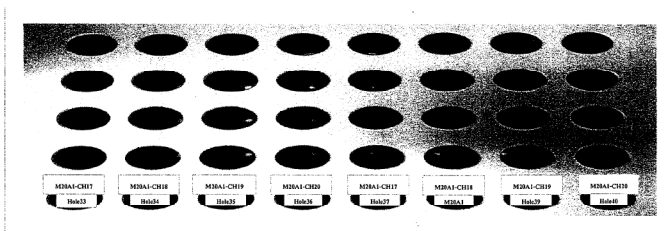
FM-L13 108/30-05-57



Certificate No. T230902

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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
380.0	380.0	379.4 - 380.7		MDIAI-CH17	MDIAI-CH18	MDIAI-CH19	MDIAI-CH20	MDIAI-CH21	MDIAI-CH22	MDIAI-CH23	MDIAI-CH24
			Max °C	377.7	378.0	378.3	379.0	378.2	378.5	377.3	377.4
			Min °C	377.3	377.6	377.9	378.6	377.7	378.1	376.9	377.0
			Average °C	377.5	377.8	378.1	378.8	378.0	378.3	377.1	377.2
			Stability ± °C	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

The expanded uncertainty of temperature measurement was ± 1.85 °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.

FM-L13 108/30-05-57

Certificate No. T222502

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Oven)

Manufacturer : Memmert

Model : UF 450

Serial No. : B7170531

Customer Code : BKK_EN0273

ID No. : T8042A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250

Customer Location : Oven Room

Date of Receipt : 23 November 2022

Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By : /Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 09 DEC 2022

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. T222502

Page 2 of 4

Calibration Report

Equipment : Chamber (Oven)
Date of Calibration : 29 November 2022
Environment : Temperature : 29.1-29.6 °C
Line Voltage : 221.3-223.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine resistance thermometer detectors and nine standard thermocouples type T into its chamber , the other one resistance thermometer detector 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
RTD	100 ohm	27-(CH1-10)	T210004	30 December 2022
TC	TYPE T	TN261-TN270	T210010	30 December 2022
DATA LOGGER	34970A	T149	T210004	30 December 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 1 Hour 49 Minute At 104 °C
Fresh Air Damper ☒ Open ☐ Min ☐ Medium ☒ Max
☐ Close
☐ Not Available

5. Adjustment :

() without adjustment (X) after adjustment

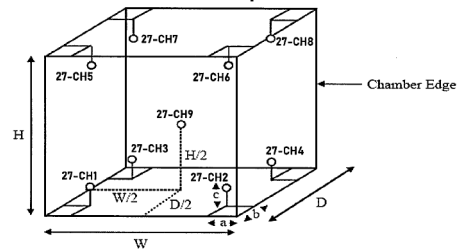
Approved By.

FM-L15 11/15-05-63

Certificate No. T222502

Page 3 of 4

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 104 cm. , H (Height) = 72 cm. and D (Depth) = 60 cm.
Size of Installed Standard sensor number 27-CH1 to number 27-CH8 : a = 5 cm, b = 5 cm. and c = 5 cm.
Size of Installed Standard sensor number 27-CH9 : W/2 = 104 cm/2 , H/2 = 72 cm/2 and D/2 = 60cm/2

Measurement Results

Average Standard Reading at each position (°C)								
Calibration Point	27-CH1	27-CH2	27-CH3	27-CH4	27-CH5	27-CH6	27-CH7	27-CH8
104	104.07	103.60	103.45	104.02	104.47	103.57	104.59	103.78

Chamber (Oven)		Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)
	Min , Max	Average				
104.0	-	104.0	103.97	0.07	0.70	0.42

* 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 % .

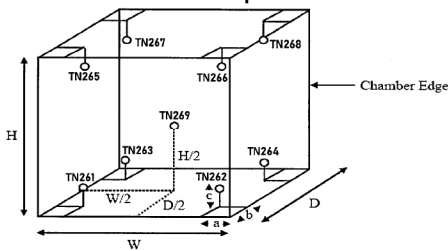
Approved By.

FM-L15 11/15-05-63

Certificate No. T222502

Page 4 of 4

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 104 cm. , H (Height) = 72 cm. and D (Depth) = 60 cm.
Size of Installed Standard sensor number TN261 to number TN268 : a = 5 cm, b = 5 cm. and c = 5 cm.
Size of Installed Standard sensor number TN269 : W/2 = 104 cm/2 , H/2 = 72 cm/2 and D/2 = 60cm/2

Measurement Results

Average Standard Reading at each position (°C)								
Calibration Point	TN261	TN262	TN263	TN264	TN265	TN266	TN267	TN268
180	179.14	179.17	179.65	179.26	180.41	179.64	181.18	180.59

Chamber (Oven)		Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)
	Min , Max	Average				
180.0	-	180.0	179.98	0.38	1.78	1.10

* 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.

FM-L15 11/15-05-63



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

Cert.No.: 22TW122
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J101147
ID No. : BKK_EN0017
Received Date : 20 May 2022
Test Date : 24 May 2022
Reference : 2205-0638DSC-8
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Warakorn Lernagatrakul
Approved by :
Approved Signatory
(/) Malee Butkruea
() Sathip Meangmai
() Warakorn Lernagatrakul

Issue Date : 31 May 2022

B 0285244



Cert.No.: 22TW122
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	21MM430	21 Sep 2022

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 16K100498

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.13	0.015

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

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a 1110482



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0 2717 3000-27 FAX. 0 2719-9484



Cert. No.: 22LM83
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J 101147
ID No. : BKK_EN0017
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 20 May 2022
Calibrated Date : 30 May 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Tawatchai Pama

Approved by :
Approved Signatory

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

Issue Date : 31 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.

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. T230683

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Incubator)

Manufacturer : MEMMERT

Model : ICP 750

Serial No. : F818.0075

Customer Code : BKK_EN0305

ID No. : T9571A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab 2

Date of Receipt : 30 March 2023

Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By : / Boonchai Suriyawong (Assistant Calibration Manager)

Date of Issue : 10 APR 2023

REVIEW BY	
APPROVED BY	
NEXT CAL DATE	05/04/24

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

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

a 1090806

Certificate No. T230683

Calibration Report

Page 2 of 4

Equipment : Chamber (Incubator)
Date of Calibration : 5 April 2023 (Finished Time 4:30 PM)
Environment : Temperature 22.9-28.6 °C
Line Voltage 221.7-225.5 V

Condition of this results of test :

- This instrument was calibrated by insert 12 standard resistance thermometer into its chamber and test 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 may be obtained upon request.
The temperature scale used was based on ITS - 90.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	37-(CH1-10)	T222493	28 November 2023
RTD	100 ohm	36-(CH1-10)	T222493	28 November 2023
DATA LOGGER	34970A	T193	T222493	28 November 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

UUC Description :

Time Constant 2 Hour 24 Minute At 20 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Result of test :

() without adjustment (X) after adjustment

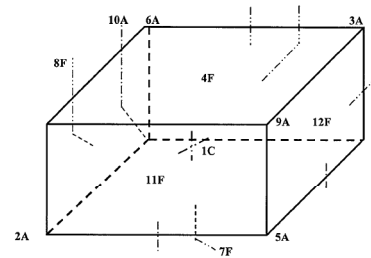
Approved By _____

FM-L15 11/7/15-05-63

Certificate No T230683

Calibration Report

Page 3 of 4



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

1C =	37CH1
2A =	37CH2
3A =	37CH3
4F =	37CH4
5A =	37CH5
6A =	37CH6
7F =	37CH7
8F =	37CH8
9A =	37CH9
10A =	37CH10

11F =	36CH1
12F =	36CH2

Approved By _____

FM-L15 11/7/15-05-63

Certificate No. T230683

Calibration Report

Page 4 of 4

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)									
	37CH1	37CH2	37CH3	37CH4	37CH5	37CH6	37CH7	37CH8	37CH9	37CH10
20.0	20.32	20.28	20.17	20.22	20.22	20.04	20.17	19.74	20.31	19.93
	36CH1	36CH2								
	20.14	20.20								
Calibration Point	37CH1	37CH2	37CH3	37CH4	37CH5	37CH6	37CH7	37CH8	37CH9	37CH10
25	25.28	25.15	25.13	25.13	25.20	25.02	25.11	24.79	25.20	25.26
	36CH1	36CH2								
	25.13	24.94								

Chamber (Incubator)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min, Max	Average					
20.0	19.9, 20.1	20.0	20.02	0.09	0.54	0.38	2.00
25.0	24.9, 25.1	25.0	25.03	0.03	0.51	0.38	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 _____

FM-L15 11/7/15-05-63

Certificate No.T230352

Page 1 of 5

Certificate of Calibration

Equipment : HOT BLOCK

Manufacturer : Environmental Express

Model : B3000- 240

Serial No. : 2017CODW116

Customer Code : BKK_EN0222

ID No. : T6769A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab2

Date of Receipt : 21 February 2023

Calibrated By : Watcharak Puttarat (Technician)

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

Date of Issue : 20 MAR 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.

FM-L12 109/30-05-57



Certificate No. T230352

Page 2 of 5

Calibration Report

Equipment : HOT BLOCK
Date of Calibration : 1 March 2023
Environment : Temperature : 22.9-24.4 °C
Line Voltage : 222.7-227.8 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

- This equipment was calibrated by insert 20 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 .
- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN121-TN130	T222122	5 October 2023
TC	TYPE T	TN131-TN140	T222122	5 October 2023
DATA LOGGER	34970A	T150	T222122	5 October 2023
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
- Condition of calibrated item : good
Equipment Description :
Time Constant 2 Hour 22 Minute At 150 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment :
(X) without adjustment () after adjustment

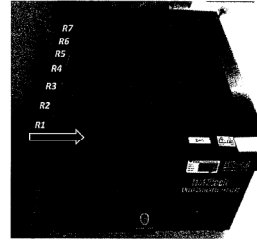
Approved By

FM-L13 108/30-05-57

Certificate N: T230352

Page 3 of 5

Calibration Report



Row	Hole							
R7	H49	H50	H51	H52	H53	H54	H55	H56
R6	H41	H42	H43	H44	H45	H46	H47	H48
R5	H33	H34	H35	H36	H37	H38	H39	H40
R4	H25	H26	H27	H28	H29	H30	H31	H32
R3	H17	H18	H19	H20	H21	H22	H23	H24
R2	H9	H10	H11	H12	H13	H14	H15	H16
R1	H1	H2	H3	H4	H5	H6	H7	H8

H: STANDARD THERMOCOUPLE TYPE T

H1	=	TN121	H9	=	TN129	H17	=	TN137	H25	=	TN125	H33	=	TN133	H41	=	TN121	H49	=	TN129
H2	=	TN122	H10	=	TN130	H18	=	TN138	H26	=	TN126	H34	=	TN134	H42	=	TN122	H50	=	TN130
H3	=	TN123	H11	=	TN131	H19	=	TN139	H27	=	TN127	H35	=	TN135	H43	=	TN123	H51	=	TN131
H4	=	TN124	H12	=	TN132	H20	=	TN140	H28	=	TN128	H36	=	TN136	H44	=	TN124	H52	=	TN132
H5	=	TN125	H13	=	TN133	H21	=	TN121	H29	=	TN129	H37	=	TN137	H45	=	TN125	H53	=	TN133
H6	=	TN126	H14	=	TN134	H22	=	TN122	H30	=	TN130	H38	=	TN138	H46	=	TN126	H54	=	TN134
H7	=	TN127	H15	=	TN135	H23	=	TN123	H31	=	TN131	H39	=	TN139	H47	=	TN127	H55	=	TN135
H8	=	TN128	H16	=	TN136	H24	=	TN124	H32	=	TN132	H40	=	TN140	H48	=	TN128	H56	=	TN136

Approved By

FM-L13 108/30-05-57



Certificate No. T230352

Page 4 of 5

Calibration Report

Measurement Results

			Average Standard Reading at each position (°C)									
Calibration Point	TN121	TN122	TN123	TN124	TN125	TN126	TN127	TN128	TN129	TN130		
Point Setting	Max	152.61	150.49	150.10	148.27	149.85	151.19	149.99	149.29	149.97	150.03	
150	Min	152.15	149.87	149.73	147.75	149.26	150.78	149.49	148.56	149.15	149.15	
	Average	152.41	150.22	149.90	147.99	149.48	150.92	149.71	148.92	149.51	149.67	
Calibration Point	TN131	TN132	TN133	TN134	TN135	TN136	TN137	TN138	TN139	TN140		
Max	149.84	148.34	148.34	149.88	152.39	149.73	149.66	149.16	149.76	151.18		
Min	149.35	147.85	148.40	148.94	152.39	149.19	148.83	148.68	149.51	150.92		
Average	149.67	148.10	148.59	149.55	152.39	149.36	149.25	148.96	149.64	151.05		
Calibration Point	TN121	TN122	TN123	TN124	TN125	TN136	TN127	TN128	TN129	TN130		
Max	152.91	150.56	149.20	148.63	149.78	151.28	150.09	148.83	148.16	148.33		
Min	152.72	150.04	148.59	147.96	149.42	150.96	149.83	148.20	147.62	147.29		
Average	152.80	150.29	148.89	148.30	149.60	151.08	149.97	148.52	147.90	147.80		
Calibration Point	TN131	TN132	TN133	TN134	TN135	TN136	TN137	TN138	TN139	TN140		
Max	148.81	148.04	148.56	148.11	149.07	149.06	148.58	149.85	149.07	150.89		
Min	148.08	147.63	148.07	147.63	148.81	148.62	148.18	149.60	148.86	150.63		
Average	148.45	147.84	148.36	147.81	148.94	148.84	148.37	149.74	148.96	150.78		
Calibration Point	TN121	TN122	TN123	TN124	TN125	TN126	TN127	TN128	TN129	TN130		
Max	150.76	152.63	151.14	150.47	151.07	150.93	149.35	150.31	149.28	149.81		
Min	150.59	152.40	150.69	150.17	150.77	150.54	148.80	149.93	148.84	149.23		
Average	150.69	152.52	150.93	150.33	150.94	150.73	149.18	150.10	149.04	149.50		
Calibration Point	TN131	TN132	TN133	TN134	TN135	TN136						
Max	150.97	150.34	151.70	149.10	153.13	150.74						
Min	150.77	149.94	151.36	148.83	152.91	150.61						
Average	150.87	150.13	151.53	148.97	153.05	150.66						

Approved By

FM-L13 108/30-05-57

Certificate No. T230352

Page 5 of 5

Calibration Report

Measurement Results

HOT BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (± °C)	Uncertainty (± °C)
	Min , Max	Average		
150.0	150 , 150.1	150.0	0.60	1.01

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

FM-L13 108/30-05-57



Bara Scientific Co., Ltd.
959 U Chu Luang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375498-7
www.barascientific.com



Certificate of Calibration

Number of Page(s) 1 of 2

Certificate No. BSCC-UV-307/22
Equipment UV/Vis Spectrophotometer
Model UV-1600
Manufacturer Shimadzu
Serial No. A1145406533CD
ID No. BKK_EN0018
Date of receipt 16 September 2022
Date of calibration 16 September 2022
Date of issue 23 September 2022

REVIEW BY *Sulok P.*
APPROVED BY *K. An*
NEXT CAL. DATE *16/9/23*

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 W-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 55917 and 55918
Photometric Accuracy is traceable to certificate No. 55924 and 55937
Stray Light is traceable to certificate No. 55905
The above certificate are traceable to SI unit through Starna Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Waruth Jangphum

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.

FM-UV-708-02 Rev.01 (23/01/63)



Bara Scientific Co., Ltd.
959 U Chu Luang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375498-7
www.barascientific.com



Certificate of Calibration

Certificate No. BSCC-UV-307/22 Number of Page(s) 7 of 3

Calibration Results:

1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±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
679.41	679.17	-0.24	0.18

2. Photometric Accuracy (UV)

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

*CNR = Customer not request

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959 U Chu Luang Building Floor 7 Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375498-7
www.barascientific.com



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 (±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
	1.0208	1.0230	0.0024	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5616	-0.0005	0.0042
	0.7455	0.7460	0.0005	0.0048
	0.9685	1.0005	0.0020	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5219	-0.0008	0.0042
	0.6660	0.6684	0.0004	0.0051
	0.8487	0.8603	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
	0.9689	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	0.0080
	1.0642	1.0943	0.0001	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5606	-0.0010	0.0042
	0.8927	0.8921	-0.0006	0.0063
	1.0681	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)
200.56±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 2.06A.

*Stray Light not NSC-ONSC Accredited.

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

End of Certificate

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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FM-UV-708-02 Rev.01 (23/01/63)



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2713-3000-27 FAX. 0-2719-9184



Cert.No.: 22CH1322
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter

Manufacturer : Mettler Toledo

Model : SevenGo pH

Serial No. : C117820932

ID No. : BKK_LG0044

Condition As-Received:

Received Date : 30 September 2022

Calibration Date : 04 October 2022

Reference : 2209-1011DSC-3

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

Ambient Temperature : (25 ± 2.5) °C

Relative Humidity : (50 ± 15) %

Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by : *Walalak*
Approved Signatory

(✓) Malee Butkruea
() Sathip Moangmal
() Warakorn Lemgagtrul

Issue Date : 6 October 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 0046069



Cert. No.: 22CH1322
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	823320	20 June 2024
pH 6.967	CPA chem	823322	20 June 2023
pH 10.015	CPA chem	794124	14 Feb 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading	Uncertainty of Measurement	Coverage factor
	pH	mV	mV	(\pm mV)	k
pH Meter	4.00	177.48	177	0.58	2.00
S/N.: C117620932	7.00	0.00	0	0.58	2.00
	10.00	-177.48	-177	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode	4.008	4.01	184	0.0079	2.00
S/N.: 2354525	6.967	6.99	10	0.011	2.00
	10.015	10.02	-167	0.0092	2.00

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

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a 1129533



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: 0-2719-0481



Cert. No.: 22LM142
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go pH
Serial No. : C117620932
ID No. : BKK_LG0044
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Location : Chemistry Calibration Lab.2
Received Order : 30 September 2022
Calibrated Date : 4 October 2022
Ambient Temperature : (26 \pm 10) °C
Relative Humidity : (50 \pm 30) %
AC Line Voltage : (220 \pm 22) V
Calibrated by : Warakorn Lemgagtrakul

Approved by :
Approved Signatory

() Ponthippa Tameyakul
() Malee Butkruea
() Suwit Imjai

Issue Date : 6 October 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 0046082



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2209-1011DSC-4
Procedure Used :-

Cert. No.: 22LM142
Page.: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	3240076	22I249	02 Mar 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 : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 2345425

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (\pm °C)	Coverage Factor k
20.0	110	20.003	19.9	-0.103	0.16	2.00
25.0	110	25.002	24.9	-0.102	0.16	2.00
30.0	110	30.004	30.0	-0.004	0.16	2.00
35.0	110	35.005	35.0	-0.005	0.16	2.00
40.0	110	40.003	40.0	-0.003	0.19	2.00
45.0	110	45.003	45.0	-0.003	0.19	2.00
50.0	110	50.002	50.0	-0.002	0.19	2.00

UUC* : Unit Under Calibration

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

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a 1129888



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL: 0-2717-3000-27 FAX: 0-2719-0481



Cert.No.: 22CH1600
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : B524047604
ID No. : BKK_LG0030
Condition As-Received : Used Item
Received Date : 16 November 2022
Calibration Date : 17 November 2022
Reference : 2211-0573DSC-6
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Ambient Temperature : (25 \pm 2.5) °C
Relative Humidity : (50 \pm 15) %
Calibration Procedure :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

Calibrated by : Warakorn Lemgagtrakul

Approved by :
Approved Signatory

() Malee Butkruea
() Sathip Meangmai
() Warakorn Lemgagtrakul

Issue Date : 22 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0047839



Cert. No.: 22CH1600
Page: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	823320	20 June 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 (\pm mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: B524047604	4.00	177.48	177	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-176	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 1471374	4.008	4.01	185	0.0071	2.00
	6.987	7.00	12	0.011	2.00
	10.008	10.01	-164	0.0096	2.00

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

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a 1136982



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
504 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL.: 0-2717-3000-27 FAX: 0-2719-9184



Cert. No.: 22LM159
Page: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor

Manufacturer : Mettler Toledo

Model : Seven2Go

Serial No. : B524047604

ID No. : BKK_LG0030

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

Location : TPA On Site Calibration Laboratory

Received Order : 16 November 2022

Calibrated Date : 18 November 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Kunchit Promprat

Approved by :
Approved Signatory

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

Issue Date : 24 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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

A 0048003

BKK_EL0036



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2211-0573DSC-7
Procedure Used :-

Cert. No.: 22LM159
Page: 2 of 2

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1502A	A52847	2211325	31 Oct 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 : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1471374

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading	Error (°C)	Uncertainty (\pm °C)	Coverage Factor k
20.0	100	20.002	20.1	0.098	0.16	2.00
25.0	100	25.003	25.2	0.197	0.16	2.00
30.0	100	30.004	30.2	0.196	0.16	2.00
35.0	100	35.001	35.3	0.299	0.16	2.00
40.0	100	40.002	40.3	0.298	0.16	2.00
45.0	100	44.999	45.3	0.301	0.16	2.00
50.0	100	50.001	50.3	0.299	0.16	2.00

UUC* : Unit Under Calibration

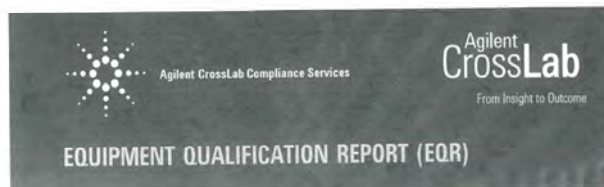
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.

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a 1137336

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Agilent CrossLab Compliance Services



Agilent CrossLab Compliance

Qualification Type: ICPMS-OQ

System ID: JP12091612

EQP Name: Agilent Recommended

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 Phatthanakan 40, Suan Luang, Bangkok 10250 Thailand.

REVIEW BY: Jattapan C.
APPROVED BY: Satchin N.
NEXT CAL DATE: 11/12/23

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

Page 1/30

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

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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		

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

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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

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

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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	G3282A
Serial Number	4N1220700

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

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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.

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

Page 6 / 30

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

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

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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

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

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

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Autotune

Purpose

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

Setpoint

Results

Peakwidth Mass 7 0.735 AMU

Agilent Recommended:

>= 0.65
<= 0.80

Status:

Pass

Peakwidth Mass 89 0.732 AMU

Agilent Recommended:

>= 0.65
<= 0.80

Status:

Pass

Peakwidth Mass 205 0.746 AMU

Agilent Recommended:

>= 0.65
<= 0.80

Status:

Pass

Mass Axis 7 7.00 AMU

Agilent Recommended:

>= 6.9
<= 7.1

Status:

Pass

Mass Axis 89 89.00 AMU

Agilent Recommended:

>= 88.9
<= 89.1

Status:

Pass

Mass Axis 205 205.00 AMU

Agilent Recommended:

>= 204.9
<= 205.1

Status:

Pass

Date: June 14, 2022 10:32:16 AM
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Mass 7 Sensitivity No Gas

Agilent Recommended:

Status:

81.18 Mcps/ppm
>= 25.5
Pass

Mass 89 Sensitivity No Gas

Agilent Recommended:

Status:

247.81 Mcps/ppm
>= 85
Pass

Mass 205 Sensitivity No Gas

Agilent Recommended:

Status:

184.87 Mcps/ppm
>= 51
Pass

Mass 59 Sensitivity He

Agilent Recommended:

Status:

84.86 Mcps/ppm
>= 20.4
Pass

Oxide Ratio 158/140

Agilent Recommended:

Status:

1.119 %
<= 1.38
Pass

Doubly Charged Species Ratio 70/140

Agilent Recommended:

Status:

1.140 %
<= 2.3
Pass

Setpoint Status: Pass

Runs: 1

Overall Autotune Test Status

Pass

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

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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):

Measured Value: 7 4,900 89 7,100 205 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

Date: June 14, 2022 10:32:16 AM
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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: 21,100 cps
Agilent Recommended: <= 460
Status: Pass

Setpoint Status: Pass

Runs: 1

Overall Background (Gas Mode) Test Status

Pass

Date: June 14, 2022 10:32:16 AM
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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, 69, 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

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

Date: June 14, 2022 10:32:16 AM
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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
EQR	General	Test Report	24
EQR	General	Test Report	26

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System ID: JP12091612

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General

Document Name: Certificate of System Qualification

 Agilent Technologies

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 isolated 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	8	Conforms
UV-vis Spectrophotometer	12	Conforms

Overall Qualification Status
Conforms

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

Document Name: Operator's training certificate and qualifications

Agilent Technologies

Certificate of Completion

Learner Name: Panthep Kurasthain

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

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

Document Name: Certificate of Qualification for ACE

Agilent Technologies

Certificate of Completion

Learner Name: Panthep Kurasthain

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.

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

Document Name: Certificate of Qualification for ACE

Agilent Technologies

Certificate of Completion

Learner Name: Panthep Kurasthain

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.

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General

Document Name: Tune reports

Tune Report

Operator Name: Supakorn Mak

Acq/Date Batch: C:\Agilent\CPM\H1\Tune01

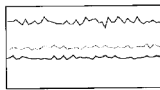
Acq. Date-Time: 6/14/2022 9:02:15 AM

Report Comment: PMOQ 14 June 2022

Instrument Name: GC81A JP12091612

[No Gas]

Sensitivity



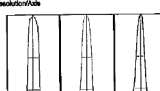
Mass	Ratio	Count	RES%	Background
7	10000	8118	3.585	1.800
89	50000	24781	3.128	2.100
205	50000	15487	3.808	18.455

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

Old/New Charged Ratio

Oxide: 156 / 143 1.115 %
Doubly Charged: 20 / 143 1.403 %

Resolution/Width



Mass	Peak Height	Area	%Area	FWHM
7	1600.0	0.03	0.02	0.125
89	24728.51	89.26	0.57	0.122
205	16599.51	205.00	0.49	0.146

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

Tune Parameters

Plasma Parameters	Nebulizer Gas	Makeup Gas
Plasma Mode: ---	1.65 L/min	0.03 L/min
RF Power: 1550 W	Option Gas: ---	Auxiliary Gas: 0.80 L/min
RF Matching: 1.85 V	Nebulizer Pump: 0.10 psi	Plasma Gas: 15.0 L/min
Sample Depth: 8.0 mm	SIC Temp: 2 °C	

Laser Parameters

IS9901 1	IS9902 1	IS9903 1	IS9904 1
1.00 V	1.00 V	1.00 V	1.00 V
Extract 2: -160.0 V	Extract 2: -160.0 V	Extract 2: -160.0 V	Extract 2: -160.0 V
Omega Bias: -80 V	Omega Bias: -80 V	Omega Bias: -80 V	Omega Bias: -80 V

Cell Parameters

Use Gas	3rd Gas Flow	Energy Dispersation
He Flow: 0.6 mL/min	CoP Bias: -8.0 V	5.0 V

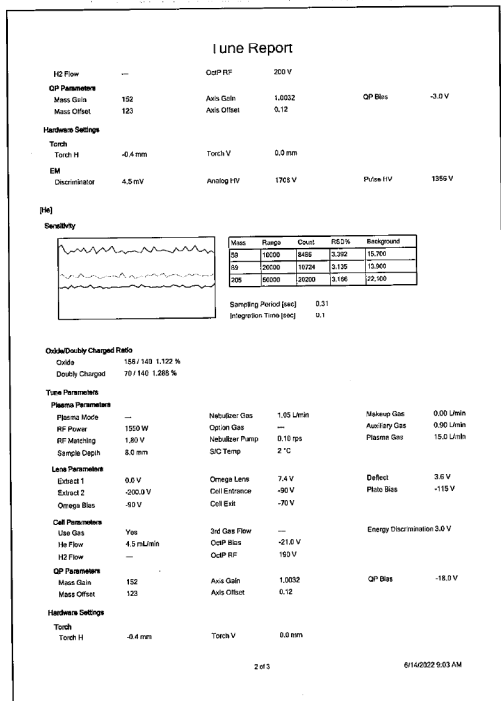
1 of 3 6/14/2022 9:02 AM

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

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Document Name:

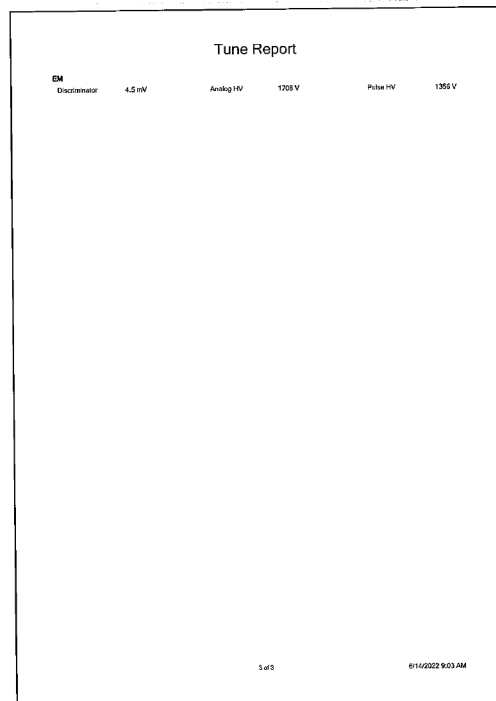
Tune reports

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

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Document Name:

Tune reports

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

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General

Document Name:

Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\PMOQ 13-4-22\BGI HeB
Analysis File: BGI He batch.bm
Tune Step: #1 He

Run	Acq. Date/Time	Data File	Sample Name	Type	Level	Relative
1	6/14/2022 10:03:38 AM	BGI HeB.bm	BGI He	Sample	1.0000	

Page 1 / 2 6/14/2022 10:03:44 AM

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

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Document Name: Test Report

Batch Summary Report

Analyze Table

Sample Name	CPS	CPS STD
1 BGI He	23.1000	38.0

Page 2 / 2 6/14/2022 10:03:44 AM

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

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General

Document Name: Test Report

Batch Summary Report							
Batch Folder:		D:\Agilent Service\PMDC\13-6-22\OQ 20 Min.b\					
Analysis File:		OQ 20 Min.batch.bln					
Tune Step:		#1 No Gas					
Run	Acq. Date/Time	Batch File	Sample Name	Type	Loc	Duration	
1	6/14/2022 9:29:27 AM	2015MPL.d		10 min	Sample		1.0000

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6/14/2022 9:53:59 AM

Date: June 14, 2022 10:32:16 AM
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Document Name: Test Report

Batch Summary Report							
Analysis Title		7 - 1 No Gas 1		9 - 1 No Gas 1		99 - 1 No Gas 1	
Sample Name	CPS	CPS RSD	CPS	CPS RSD	CPS	CPS RSD	CPS
10 min	62477.8975	0.3	265.3875	5.0	19201.0095	0.7	24121.9700
140 - 1 No Gas 1		205 - 1 No Gas 1					
Sample Name	CPS	CPS RSD	CPS	CPS RSD			
10 min	242452.6980	0.7	38154.8205	0.6			

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6/14/2022 9:53:59 AM

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

Purpose

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Details

Full Name of Signer: Panthep Kurasathain
Logged On User Name: panthep_kurasathain@agilent.com
Signature Creation Date: June 14, 2022
Reason for Signature: Executed protocol and published this original version of document

Regulatory Disclaimer

This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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

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User Name: panthep_kurasathain		System ID: JP12091612	
Host Name: ASDHKKW313		Print Date: June 14, 2022 10:32:26 AM	
ALS OQHV 7790 14Jun2022 Transaction log :			
Time	Transaction State	Activity Performed	Optional Information
June 14, 2022 10:14:43 AM	Audit	SessionCreated	Session
June 14, 2022 10:14:43 AM	Start	Configuration	Session
June 14, 2022 10:14:43 AM	Audit	Enrollment	User is FieldEngineer and does not require an unlock code
June 14, 2022 10:18:18 AM	Audit	EqpLeased	Session
EQP details for primary technique [IcpMtx] - File path: [ProtocolPacks\IcpMtx\Config\enations\02.50\IcpMtx.02.50.c eq], EQP File Name: [IcpMtx.02.50.eq], EQP Name: [AgilentRecommended]			
June 14, 2022 10:19:20 AM	End	Configuration	Session
June 14, 2022 10:19:24 AM	Start	Qualification	Session
June 14, 2022 10:19:24 AM	Start	Execution	Autosampler Check : ASX-520: None
June 14, 2022 10:19:42 AM	End	Execution	Autosampler Check : ASX-520: 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
June 14, 2022 10:19:47 AM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2: Integrated Sample Introduction System (ISIS) Check
June 14, 2022 10:19:50 AM	Start	Execution	Autotune : G3291A: Autotune 1
June 14, 2022 10:22:22 AM	End	Execution	Autotune : G3291A: Autotune 1 Run Count: 1

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

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User Name: pandhig_kuratsithien
Hostname: ASBKW0313

System ID: JP12091612
Print Date: June 14, 2022 10:32:30 AM

ALS OQIW 7703 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 10:23:46 AM	Start	Execution	Background (Gas Mode) : G3281A: Gas Mode Background :Helium	None
June 14, 2022 10:23:55 AM	End	Execution	Background (Gas Mode) : 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 10:24:08 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 10:30:29 AM	Audit	Reporting	Session	Report Generated : Certificate
June 14, 2022 10:30:39 AM	Audit	Reporting	Session	Report Generated : Report

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

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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 80

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

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Background (No Gas Mode)

Setpoint Status:

Pass

Masses (AMU):

Measured Value:

Agilent Recommended:

Status:

7	89	205
4,900	7,100	18,400
10	10	30
Pass	Pass	Pass

Overall Background (No Gas Mode) Test Status

Pass

Background (Gas Mode)

Gas Mode: Helium

Setpoint Status:

Pass

Mass (AMU):

Measured Value:

Agilent Recommended:

Status:

78
21,100
1460
Pass

Overall Background (Gas Mode) Test Status

Pass

20-Minute Stability (No Gas Mode)

Masses (AMU):

Stability RSD:

Agilent Recommended:

Status:

7	89	205
0.2	0.6	0.6
3.45	3.45	3.45
Pass	Pass	Pass

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

Pass

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

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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

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

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Electronic Signature

Purpose

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Details

Full Name of Signer: Panthep Kurasathain
Logged On User Name: panthep_kurasathain@agilent.com
Signature Creation Date: June 14, 2022
Reason for Signature: Executed protocol and published this original version of document

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This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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

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User Name: panthep_kurasathain System ID: JP12091612
Hostname: ASBKKW313 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		Session/Created	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 Field Engineer and does not require an unlock code
June 14, 2022 10:18:18 AM Audit		EqLoaded	Session	EQP details for primary technique [EqMs] - File path: [ProtocolPacks\eqMs\Config\version02.50\eqMs.02.50.a eq], EQP File Name: [eqMs.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-500	None
			Autosampler Check:	
June 14, 2022 10:19:42 AM End		Execution	Autosampler Check : ASX-500	Run Count : 1
			Autosampler Check	
June 14, 2022 10:19:43 AM Start		Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2	None
			Integrated Sample Introduction System (ISIS) Check	
June 14, 2022 10:19:47 AM End		Execution	Integrated Sample Introduction System (ISIS) Check : ISIS2	Run Count : 1
			Integrated Sample Introduction System (ISIS) Check	
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

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

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User Name: panthep_kurasathain System ID: JP12091612
Hostname: ASBKKW313 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 10:22:49 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 Mode) : G3281A: Gas Mode Background Helium	None
June 14, 2022 10:23:35 AM End	Execution		Background (Gas Mode) : 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 10:24:06 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

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

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User Name: panthep_kurasathain System ID: JP12091612
Hostname: ASBKKW313 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 10:32:28 AM Audit		Reporting	Session	Report Signed : Report PDF Name: ALS OQHW 7700 14Jun2022_2020614_OQ Report_1.pdf User Name: panthep_kurasathain@agilent.com Full Name of Signer: Panthep Kurasathain Reason for signature: Executed protocol and published this original version of document

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


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



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 
APPROVED BY 
NEXT CAL. DATE 7/10/23

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

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

FM-L12 109/30-05-17

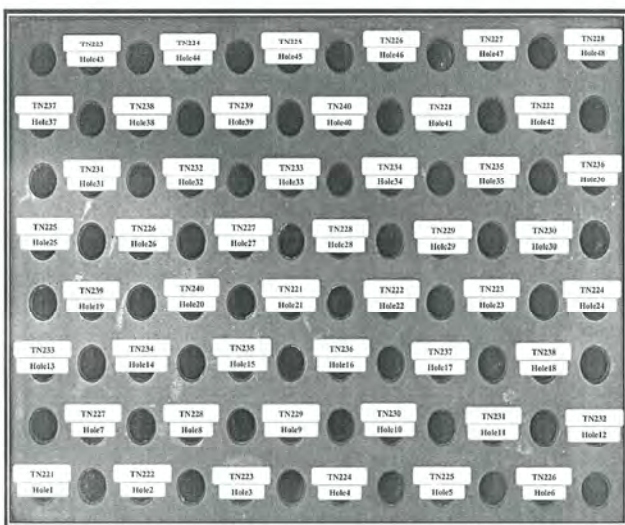
FM-L13 108/30-05-17



Certificate No. T220730

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By: 

FM-L13 108/30-05-17



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 :

- 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.
- 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
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TIS-TIS 17025 CALIBRATION 0241.)
- 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
- Adjustment :
 () without adjustment (X) after adjustment

Approved By: 



Certificate No. T220730

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Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	TN221	TN222	TN223	TN224	TN225	TN226
CAL. POINT	Max	93.60	93.82	94.05	94.20	94.36
	Min	93.07	93.26	93.51	93.66	93.82
Average	93.33	93.54	93.78	93.93	94.09	94.26
R2 Hole7-Hole12	TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.59	94.79	94.63	94.55	94.82
	Min	94.05	94.25	94.08	93.97	94.26
Average	94.32	94.52	94.36	94.26	94.54	94.72
R3 Hole13-Hole18	TN233	TN234	TN235	TN236	TN237	TN238
	Max	95.03	94.54	94.78	94.84	95.06
	Min	94.40	93.99	94.20	94.28	94.40
Average	94.74	94.26	94.49	94.56	94.79	94.45
R4 Hole19-Hole24	TN239	TN240	TN221	TN222	TN223	TN224
	Max	94.89	94.82	95.73	95.85	95.73
	Min	94.33	94.26	95.51	95.62	95.51
Average	94.61	94.54	95.62	95.73	95.62	95.97
R5 Hole25-Hole30	TN225	TN226	TN227	TN228	TN229	TN230
	Max	96.28	96.30	96.37	96.54	96.04
	Min	96.01	96.10	96.02	96.20	95.89
Average	96.15	96.24	96.20	96.37	96.04	95.88
R6 Hole31-Hole36	TN231	TN232	TN233	TN234	TN235	TN236
	Max	96.84	96.97	97.03	96.48	96.33
	Min	96.53	96.65	96.71	96.08	95.98
Average	96.68	96.81	96.87	96.28	96.16	95.60
R7 Hole37-Hole42	TN237	TN238	TN239	TN240	TN221	TN222
	Max	96.46	96.15	96.19	96.06	96.95
	Min	96.12	95.84	95.85	95.72	96.64
Average	96.30	95.99	96.02	95.89	96.30	96.79
R8 Hole43-Hole48	TN223	TN224	TN225	TN226	TN227	TN228
	Max	96.91	96.58	96.13	96.19	96.34
	Min	96.55	96.21	95.80	95.87	96.03
Average	96.73	96.40	95.96	96.03	96.18	96.03

Approved By: 

FM-L13 108/30-05-17



Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T220730

Page 5 of 6

Calibration Report

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

FM-L13 10820-05-57

BKK_EL0023

analytikjena
An Expertise Partner Company

REVIEW BY	สมชาย T
APPROVED BY	สมชาย N
NEXT CAL. DATE	24/05/24

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur DUO /
mercur DUO plus



Metrological Center

SCI ECO Services Company Limited

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

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

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

Certificate No. T220730

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Calibration Report

Measurement Results:

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

* The quoted uncertainty exclude * uniformity *

The calibration result apply only the above calibrated item.

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

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

Approved By.

FM-L13 10820-05-57

Serial-No.: K170A0143 Customer-No.:
Date: 24 May 2023 Carried out by: Srichai Fak-on

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

Company	บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด
User	
Department	ห้องแล็บปฏิบัติการ
Street	104 ซอย 40 ถนนพัฒนาการ แขวงสวนหลวง เขตสวนหลวง
Zip Code, City	กรุงเทพมหานคร 10250
Country	ประเทศไทย
Phone	
Fax	
E-mail	

Maintenance works basic unit

- tightness visual check inside the Mercur ☒
- visual check if gold-traps are broken ☒
- visual check if spectrometer is contaminated ☒
- visual check of the fluorescence cell ☒
- visual check of the absorption cell, incl. window ☒
- reactor cleaning ☒
- check pump-hose, if necessary change it ☒
- check swivel drive (SEV) ☒
- check drying-hose, output gas-liquid-separator ☒
- test Bubble-Sensor ☒
- check gas flows ☒
- check volume flows, reagents ☒
- recording stray light values ☒
- measurement with 30 ng/l ☒

Maintenance works Autosampler

Serial No.: 701 739

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

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Swivel drive (SEV)	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"/>
Check gasflow		
Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
Valve 1	10 Nl/h or 0.166 NL/min	0.163 NL/min
Valve 2	50 Nl/h or 0.833 NL/min	0.403 NL/min
Valve 3	5 Nl/h or 0.083 NL/min	0.140 NL/min
Valve 4	10 Nl/h or 0.166 NL/min	0.108 NL/min
Check liquidflow		
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
Adventitious light - values (V)	from file	
100	0	0
200	0	0
300	0	0
350	0	0
400	0	0
450	2	2
500	5	5
550	10	10
575	15	14
600	20	20

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max.conc.: 10µg/L PMT-voltage: 360 V		
Blank-solution without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int 0.00024 Int 0.00172 RSD 0.45 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: 352 V		
Blank-solution with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int 0.00370 Int 0.01060 RSD 2.38 %
Fok.- factor (Int ₂ / Int ₁)	> 3.5	6.16
Analytical parameters Absorption cell		
Blank-solution without enrichment / FBR 100 ng/L	Ext > 0.0012 RSD < 5 %	Ext 0.00093 Ext 0.00449 RSD 2.58 %
Comments		

Sachai Pahan.
Signature Technician24 May 2023
Place, Date (DD/MM/YYYY)Orawan T.
Signature Customer24 May 2023
Place, Date (DD/MM/YYYY)

Service Report

Customer's address:	Customer's Ref. No.			
SAR, MARIKAWA, PAKKONG, 11301 THAILAND				
FOR THE MAINTENANCE AND REPAIRING OF THE MERCUR DUO				
E-mail:	Phone:	Fax:		
Job No. 2305282 PM	User:	Service Engineer: NIKU WONG		
Instrument model: Mercur	Serial No. K170A0143	Software Version No. 4.7.10.0		
<input type="checkbox"/> Repair (RE)	<input checked="" type="checkbox"/> Maintenance (PM)	<input type="checkbox"/> Installation (IN)		
<input type="checkbox"/> Warranty	<input type="checkbox"/> Application (AP)	<input type="checkbox"/> Site Prep (SP)		
<input type="checkbox"/> Visit (VI)				
Fault / Claim: - production problem of the unit for No. 2300112 / (INV2308-037)				
- perform PM Contract Year 2023 (1 Time / Year 2023)				
Action taken: - Maintenance not Basic Unit				
- Check Device parameter				
- Check gas flow				
- Check liquid flow				
- Check Adventitious light - values				
# Test run Analytical parameter Fluorescence cell				
# Test run Analytical parameter Absorption cell				
Action Pending / Recommendation: maintenance for the unit				
<input type="checkbox"/> Spare Part				
<input type="checkbox"/> Instrument Configuration				
Item No.	Name	Quantity	Unit Price	
1.				
2.				
3.				
4.				
5.				
6.				
7.				
Hearwith the undersigned confirm the facts stated, the work performed, the perfect function of this device, and the receipt/delivery of the specified spare parts. *Traveled hours and kilometers can only be entered after the return of the service engineer.		Date / Signature of Customer	Date / Signature of Service Engineer	Work completed?
		Orawan T.	NIKU WONG	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Mercur

Report file: C:\WinAAS\TMP\2023\May\Pro_032
 Program version: 4.7.10.0 Printed on: 5/24/2023 12:46
 Recording started on 5/24/2023 12:35 GMT+7.0
 Operator: PSU,OTA
 Laboratory: ALS-BKK
 Code: li_Hg005_2023
 Remarks:
 Food,water

Method parameters**Hg**

Method Without enrichment / FBR 30ng/L_PM24052023
 Created on 5/24/2023 Time 12:27
 Program --

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	30 s
PMT	360 V		
AZ time	5 s	Peak smoothing	8/5
Delay	0 s		
Working mode	w/o enrich	System cleaning	Acid
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	5 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	28 s		
Purge time2	15 s	Gas wash time2	10 NL/h

Autosampler

Autosampler	AS51S/F	Tray type	87/139
Working mode	continuous		

Dilution

Mercur

QC parameters

QC type	Conc. check	
QC check samp. 1	---	QC check samp. 2
Conc.	---	Conc.
Error limit	---	Error limit
Rep. measurement	off	Reaction
QC std. 1 no.	1(30.000 ng/L)	QC std. 2 no.
QC std. 1 limit	± 50.00%	QC std. 2 limit
QC std. act.	flag + continue	
Expect. blank abs.	0.0100± 0.0100	Reaction
QC precision	off	flag + continue
		Reaction
		QC Recal.factor
		Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/l	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confd. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards**Hg**

No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(-)	79	0.000	H: 0.000249 A: 0.004274	0.000132 0.001698	53.13 39.72
2	Cal-Std1	(-)	80	30.000	H: 0.001720 A: 0.02172	0.000007 0.000023	0.459 0.107

Mercur

Calibration function 1

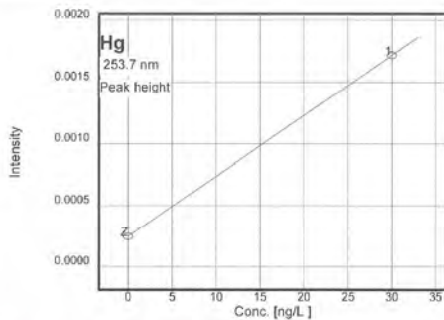
5/24/2023 12:44 Calibration (Peak height)

Ints=k1+k2*conc

k1=0.000249 k2=0.000049

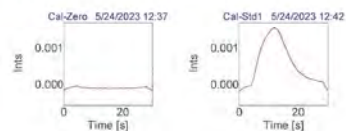
Recal. factor: ---

Slope	0.00005 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

**Measurements and events (sorted by time)**

Hg	Without enrichment / FBR 30ng/L_PM 24052023	5/24/2023	12:35
ID	Conc.	Ints	Int. type
Cal-Zero		0.000143	PkH
		0.000397	
		0.000207	
	0ng/L	0.000249	
		0.001324	53.13
Cal-Std1		0.001720	PkH
		0.001712	
		0.001728	
	30.00ng/L	0.001720	
		0.00007897	0.459
Calibration	Calibration function: 01		12:44

Mercur

Peak plots**Hg**

Mercur

Mercur

Report file: C:\WinAAS\TMP2023\May\Pro_033
 Program version: 4.7.10.0 Printed on: 5/24/2023 14:01
 Recording started on 5/24/2023 13:37 GMT+7.0
 Operator: PSU.OTA
 Laboratory: ALS-BKK
 Code: II_Hg055_2023
 Remarks:
 Food,water

Method parameters**Hg**

Method: Enrichment / FER 30ng/L PM_24052023
 Created on 5/24/2023 Time 13:36
 Program: ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	40 s
PMT	352 V		
AZ time	5 s	Peak smoothing	12/11
Delay	0 s		

Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	off	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	10 NL/h
Reaction time	10 s		
Waiting time AZ	10 s	Gas AZ wait	10 NL/h
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	5 NL/h
Purge time3	20 s		
Heat time coll 1	20 s	Cool. time coll 1	30 s

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std. 1 no.	1(30.000 ng/L)	QC std. 2 no.	1(30.000 ng/L)
QC std. 1 limit	± 50.00%	QC std. 2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	off	Meas. cycles	1
Confd level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards**Hg**

No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(-)	##	0.000	H: 0.003700 A: 0.02531	0.000081 0.000153	2.192 0.607
2	Cal-Std1	(-)	##	30.000	H: 0.01060 A: 0.09589	0.000253 0.002766	2.386 4.136

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Calibration function 1

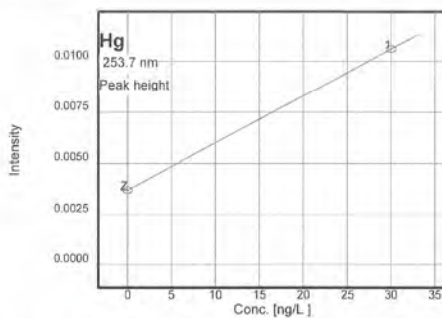
5/24/2023 14:00 Calibration (Peak height)

Ints=k1+k2*conc

k1=0.003700 k2=0.000230

Recal factor: ---

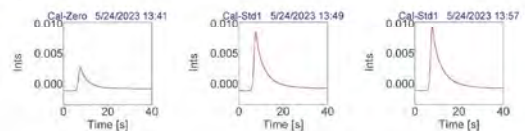
Slope	0.00023 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

**Measurements and events (sorted by time)**

Hg	Enrichment / FER 30ng/L PM_24052023				5/24/2023	13:37	
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.003792				PkH	13:41
		0.003666					13:43
		0.003540					13:44
	0ng/L	0.003700		0.000081090	2.192		13:44
Cal-Std1		0.008498				PkH	13:49
		0.008333					13:50
		0.008961					13:52
	30.00ng/L	0.008931		0.0005830	6.528		13:52
Cal-Std1		0.01031				PkH	13:57
		0.01074					13:58
		0.01076					14:00
	30.00ng/L	0.01060		0.0002530	2.386		14:00
Calibration	Calibration function: 01						14:00

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Peak plots**Hg**

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Report file: C:\WinAAS\TMP\2023\May\Pro_034
 Program version: 4.7.10.0 Printed on: 5/24/2023 14:33
 Recording started on 5/24/2023 14:19 GMT+7.0
 Operator: PSU,OTA
 Laboratory: ALS-BKK
 Code: II_Hg065_2023
 Remarks:
 Food,water

Method parameters **Hg**

Method Without enrichment / Abs / FBR 100ng/L_PM 24052023
 Created on 5/24/2023 Time 14:18
 Program ---

Parameters Mercur Technique: Hg absorption

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	55 s
PMT	225 V		
AZ time	5 s	Peak smoothing	2/5
Delay	8 s		

Working mode	w/o enrich.	System cleaning	Acid
FBR technique	on	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	5 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Delay	10 s		
Purge time1	50 s		
Purge time2	10 s	Gas wash time2	10 NL/h

Mercur

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std. 1 no.	1(100.00 ng/L)	QC std. 2 no.	1(100.00 ng/L)
QC std. 1 limit	± 50.00%	QC std. 2 limit	± 0.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards **Hg**

No	Name	State	Pos	Conc. / ng/L	Abs	SD	RSD/%
1	Cal-Zero	(-)	##	0.00	H: 0.000932 A: 0.000926	0.000138 0.000208	14.88 17.28
2	Cal-Std1	(-)	##	100.00	H: 0.004494 A: 0.001286	0.000116 0.001275	2.586 2.082

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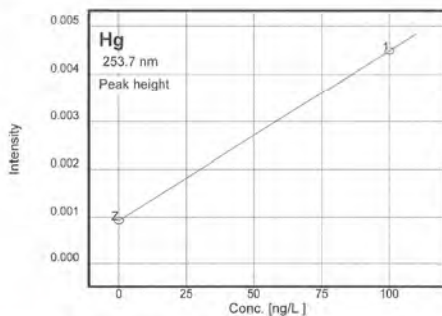
Calibration function 1 **5/24/2023 14:33 Calibration (Peak height)**

Abs=k1+k2*conc

k1=0.000932 k2=0.000036

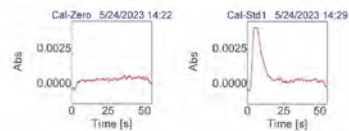
Recal factor: ---

Slope	0.00004 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	122.411 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

**Measurements and events (sorted by time)**

Hg	Without enrichment / Abs / FBR 100ng/L_PM 24052023					5/24/2023	14:19
ID	Conc.	Abs	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.001039				PxH	14:22
		0.000775					14:23
		0.000981					14:25
	0ng/L	0.000932		0.00013672	14.88		14:25
Cal-Std1		0.004528				PxH	14:29
		0.004364					14:31
		0.004589					14:33
	100.ng/L	0.004494		0.00011623	2.586		14:33
Calibration	Calibration function: 01						14:33

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Peak plots **Hg**

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