

ภาคผนวก ง

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

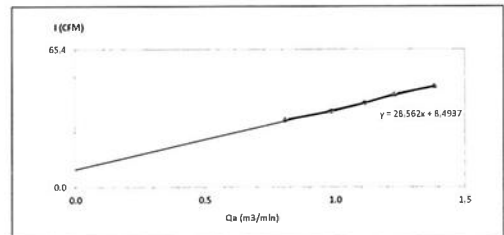
Sample Name	Parameter	Equipment Name	ID No.	Calibrate Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM-10)	High Volume	RVG_F50192	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RVG_F50191	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RVG_F50188	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RVG_F50067	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RVG_E00001	22-Feb-24	22-Feb-25	12
Ambient	Total Suspended Particulate	High Volume	RVG_F50079	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50395	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50393	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RVG_F50176	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RVG_E00010	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO _x Analyzer	RVG_F50059	3-Jan-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO _x Analyzer	RVG_F50055	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO _x Analyzer	RVG_F50063	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO _x Analyzer	RVG_F50035	3-Jul-24	3-Jan-25	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50049	20-Jun-23	20-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50044	20-Jun-23	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50031	28-Aug-24	28-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RVG_F50042	20-Aug-24	20-Feb-26	18
Stack (CEM)	Oxides of Nitrogen	Analyzer, System Calibration, Stack	-	-	-	-
Stack (CEM)	Sulfur Dioxide	Analyzer, System Calibration, Stack	-	-	-	-
Stack (CEM)	Oxygen	Analyzer, System Calibration, Stack	-	-	-	-
Stack	Total Suspended Particulate	Compu. Control Unit	RVG_F50056	16-Jul-24	16-Jan-25	6
Stack	Total Suspended Particulate	Probe, Control Unit	RVG_F50046	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Probe Tube	RVG_F50051	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Probe Tube	RVG_F50073	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Digital Balance	RVG_E00003	22-Feb-24	22-Feb-25	12
Noise	Leq 20 hrs	Sound Calibrator	RVG_F50098	20-Jan-24	23-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50092	25-Feb-24	25-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50091	25-Feb-24	25-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50093	23-Feb-24	23-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RVG_F50039	9-Oct-24	9-Oct-25	12
Noise	Noise Dose, TWA	Dose Badge Reader	RVG_F50080	26-Jan-24	26-Jan-25	12
Noise	Noise Dose, TWA	Dose Badge Reader	RVG_F50040	29-Jan-24	29-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50080	7-Aug-24	7-Aug-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50036	17-Mar-24	17-Mar-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50036	12-Jan-24	13-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50017	8-Jan-24	7-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50019	8-Aug-24	8-Aug-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50018	15-Feb-24	14-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50018	15-Feb-24	14-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50021	13-Jan-24	10-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50017	8-Jan-24	7-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50019	15-Feb-24	14-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50023	13-Jan-24	13-Jan-25	12
Heat	Heat Stress	Heat Stress Monitor	RVG_F50020	21-Jan-24	19-Jan-25	12
Illuminance	Illuminance	Lux Meter	RVG_F50071	18-Mar-24	18-Mar-25	12
Illuminance	Illuminance	Lux Meter	RVG_F50016	10-Sep-24	10-Sep-25	12
Rayong Lab	Temp at 24 °C	Temp meter	RVG_E00085	19-Jan-24	19-Jul-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RVG_E00002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	High Air Oven	RVG_E00010	21-Jan-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RVG_E00002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	High Air Oven	RVG_E00010	21-Jan-24	21-Sep-25	18
Rayong Lab	Oil & Grease	Electronic Balance	RVG_E00002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	High Air Oven	RVG_E00013	21-Jan-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Nutrient Bott	RVG_E00012	21-Jan-24	21-Sep-25	18
Rayong Lab	Temperature	Thermometer	RVG_F50008	1-Jul-24	1-Jul-25	12



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf IP NLL Co. Ltd.	Barometric Pressure (mm Hg) :	757.6
Calibrate Location :	บริษัท นิล จำกัด	Temperature (°C) :	31.6
Calibrate Date :	21-Oct-24	High Volume ID :	RYG_F50192
CalibrationSheet No.:	C-211024-RYG_F50192	High Volume Model :	TE-5009X
Calibrator ID:	RYG_F50205	High Volume S/N :	5330
Calibrator Model :	TE-5028A	Calibrator Slope :	0.95561
Calibrator S/N :	1166	Calibrator Intercept :	-0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.4	0.808	32	Slope: 28.5617
2	2.1	0.984	36	Intercept: 8.4937
3	2.7	1.113	40	Correlation Coefficient: 0.9974
4	3.3	1.220	44	
5	4.2	1.383	48	



Calibrated by ชัชชาติ สุขป้า
(Mr.Chatchai Sukpia)
Field Scientist(1)

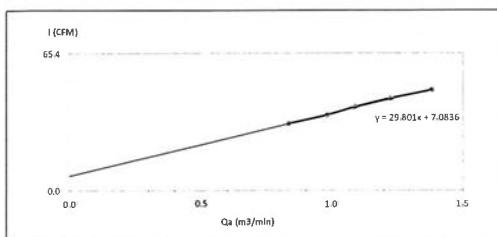
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(Mr.Noppong Jantarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf IP NLL Co. Ltd.	Barometric Pressure (mm Hg) :	757.6
Calibrate Location :	บริษัท นิล จำกัด	Temperature (°C) :	31.6
Calibrate Date :	21-Oct-24	High Volume ID :	RYG_F50191
CalibrationSheet No.:	C-211024-RYG_F50191	High Volume Model :	TE-5009X
Calibrator ID:	RYG_F50205	High Volume S/N :	5330
Calibrator Model :	TE-5028A	Calibrator Slope :	0.95561
Calibrator S/N :	1166	Calibrator Intercept :	-0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.5	0.835	32	Slope: 29.8013
2	2.1	0.901	36	Intercept: 7.8936
3	2.6	1.093	40	Correlation Coefficient: 0.9985
4	3.3	1.228	44	
5	4.2	1.303	48	



Calibrated by ชัชชาติ สุขป้า
(Mr.Chatchai Sukpia)
Field Scientist(1)

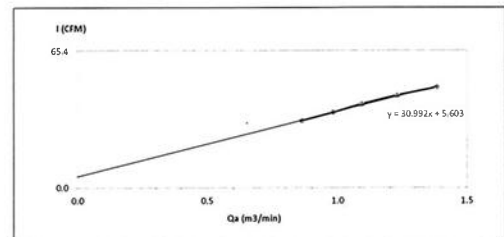
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(Mr.Noppong Jantarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf IP NLL Co. Ltd.	Barometric Pressure (mm Hg) :	757.6
Calibrate Location :	บริษัท นิล จำกัด	Temperature (°C) :	31.6
Calibrate Date :	21-Oct-24	High Volume ID :	RYG_F50188
CalibrationSheet No.:	C-211024-RYG_F50188	High Volume Model :	TE-5009X
Calibrator ID:	RYG_F50205	High Volume S/N :	4796
Calibrator Model :	TE-5028A	Calibrator Slope :	0.95561
Calibrator S/N :	1166	Calibrator Intercept :	-0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.862	32	Slope: 30.9922
2	2.1	0.984	36	Intercept: 5.6030
3	2.6	1.093	40	Correlation Coefficient: 0.9978
4	3.3	1.228	44	
5	4.2	1.383	48	



Calibrated by ชัชชาติ สุขป้า
(Mr.Chatchai Sukpia)
Field Scientist(1)

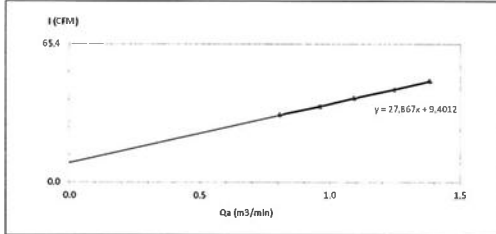
Approved by นพปง จันทรานัน
(Mr.Noppong Jantarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : Gulf JP NLL Co., Ltd. Barometric Pressure (mm Hg) : 757.6
Calibrate Location : สำนักงานปิโตรเลียมฯ Temperature (°C) : 31.6
Calibrate Date : 21-Oct-24 High Volume ID : RYG_FS0667
Calibration Sheet No. : C-211024-RYG_FS0667 High Volume Model : TE-5009X
Calibrator ID : RYG_FS0205 High Volume S/N : 6766
Calibrator Model : TE-5028A Calibrator Slope : 0.95561
Calibrator S/N : 1166 Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.4	0.808	32	Slope: 27.8675
2	2.0	0.961	36	Intercept: 9.4012
3	2.6	1.093	40	Correlation Coefficient: 0.9997
4	3.4	1.246	44	
5	4.2	1.383	48	



Calibrated by : สุภัทรา ชัย
(Mr. Chatchai Sukpaj) Field Scientist (1)

Approved by : Mr. Noppeng Juntarapan
Enviro Field Coordinator Scientist (3)

FORM NO: F 06-074 REVISION NO: 2 ISSUE DATE: 20/11/23

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8301-6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BCI0068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409664 Reference No. : 229198
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 1 of 2

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

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

Calibrated By : Mr.Chonchai Inthana Calibration Procedure No. : This calibration was conducted by
Calibration Date : Thursday, February 22, 2024 Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data : Capacity : 150 g Readability : 0.0001 g
Reasons for calibration : ☐ New Installation ☐ Service / Repair ☒ Re-calibration/ Maintenance
Ambients Conditions : Temperature : 23.8 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure : 1013 hPa ± 1 hPa
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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp. Luton MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.

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

SOP FM 33 03 February 2022

Mr.Chonchai Inthana (Technical Manager)



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8301-6 Fax: +66 2643 8307, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BCI0068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409664 Reference No. : 229198
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability				Eccentricity (Off-center loading error)			
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on its 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 test, 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)	10.0000	99.9999		Nominal value :	50	g	
10 g	10.0000	100.0000		Tolerance	0.0004	g	
Tolerance	0.0001 g	100.0001		Difference			
	10.0000	100.0001		1	-		
	9.9999	100.0000		2	-0.0001		
Nominal Value : (High Load)	10.0000	100.0001		3	0.0001		
100 g	10.0000	100.0000		4	0.0002		
Tolerance	0.0001 g	100.0001		5	0.0000		
	9.9999	100.0002		6	-		
	9.9999	100.0001					
Standard Deviation	0.00005	0.00008					

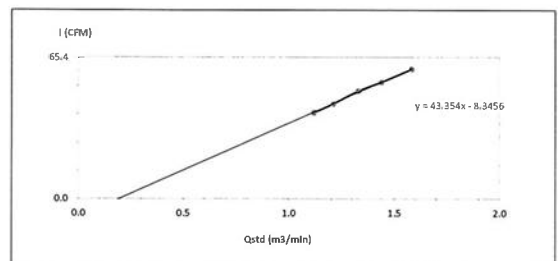
Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	0.0002 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00020
0.05	0.0500	0.0500	0.0000	0.00021
0.1	0.1000	0.1000	0.0000	0.00021
0.5	0.5000	0.5000	0.0000	0.00021
1	1.0000	1.0000	0.0000	0.00021
2	2.0000	2.0000	0.0000	0.00021
5	5.0000	5.0000	0.0000	0.00021
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00021
100	100.0000	99.9999	-0.0001	0.00024

End of Report.

High Volume Air Sampler Calibration Worksheet

Project Site : Gulf JP NLL Co., Ltd. Barometric Pressure (mm Hg) : 757.6
Calibrate Location : สำนักงานปิโตรเลียมฯ Temperature (°C) : 31.6
Calibrate Date : 21-Oct-24 High Volume ID : RYG_FS0179
Calibration Sheet No. : C-211024-RYG_FS0179 High Volume Model : TE-5170D
Calibrator ID : RYG_FS0205 High Volume S/N : 4805
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.8	1.1192	40	Slope: 43.3543
2	3.3	1.2120	44	Intercept: -8.3456
3	4.0	1.3307	50	Correlation Coefficient: 0.9989
4	4.7	1.4394	54	
5	5.7	1.5815	60	



Calibrated by : สุภัทรา ชัย
(Mr. Chatchai Sukpaj) Field Scientist (1)

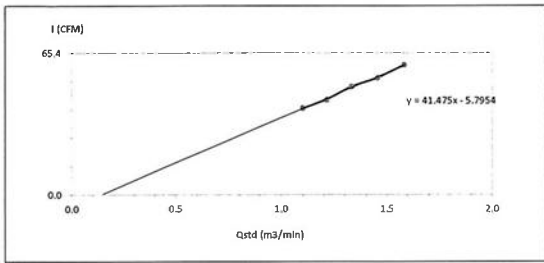
Approved by : Mr. Noppeng Juntarapan
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf P NLL Co., Ltd. Barometric Pressure (mm Hg): 757.6
Calibrate Location: ชุมชนบ้านนาหมื่น Temperature (°C): 31.6
Calibrate Date: 21-Oct-24 High Volume ID: RYG_FS0395
Calibration Sheet No.: C-211024-RYG_FS0395 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N: 5692
Calibrator Model: TE-5028A Calibrator Slope: 1.52567
Calibrator S/N: 1166 Calibrator Intercept: -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.7	1.0997	40	Slope: 41.4752 Intercept: -5.7954 Correlation Coefficient: 0.9981
2	3.3	1.2120	44	
3	4.0	1.3307	50	
4	4.8	1.4543	54	
5	5.7	1.5815	60	



Calibrated by: คุณวิชาชัย
(Mr. Chatchai Sukpia)
Field Scientist(1)

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

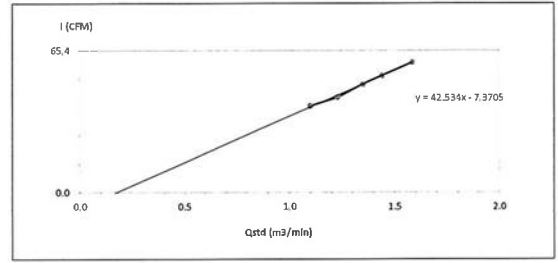
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Gulf P NLL Co., Ltd. Barometric Pressure (mm Hg): 757.6
Calibrate Location: ชุมชนบ้านนาหมื่น Temperature (°C): 31.6
Calibrate Date: 21-Oct-24 High Volume ID: RYG_FS0393
Calibration Sheet No.: C-211024-RYG_FS0393 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N: 5682
Calibrator Model: TE-5028A Calibrator Slope: 1.52567
Calibrator S/N: 1166 Calibrator Intercept: -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.7	1.0997	40	Slope: 42.5340 Intercept: -7.3705 Correlation Coefficient: 0.9975
2	3.4	1.2297	44	
3	4.1	1.3468	50	
4	4.7	1.4394	54	
5	5.7	1.5815	60	



Calibrated by: คุณวิชาชัย
(Mr. Chatchai Sukpia)
Field Scientist(1)

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

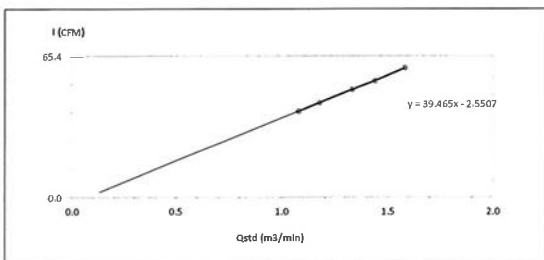
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High Volume Air Sampler Calibration Worksheet

Project Site: Gulf P NLL Co., Ltd. Barometric Pressure (mm Hg): 757.6
Calibrate Location: สถานีวิทยุการบิน Temperature (°C): 31.6
Calibrate Date: 21-Oct-24 High Volume ID: RYG_FS0176
Calibration Sheet No.: C-211024-RYG_FS0176 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N: 4802
Calibrator Model: TE-5028A Calibrator Slope: 1.52567
Calibrator S/N: 1166 Calibrator Intercept: -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0798	40	Slope: 39.4650 Intercept: -2.5507 Correlation Coefficient: 0.9998
2	3.1	1.1758	44	
3	4.0	1.3307	50	
4	4.7	1.4394	54	
5	5.7	1.5815	60	



Calibrated by: คุณวิชาชัย
(Mr. Chatchai Sukpia)
Field Scientist(1)

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

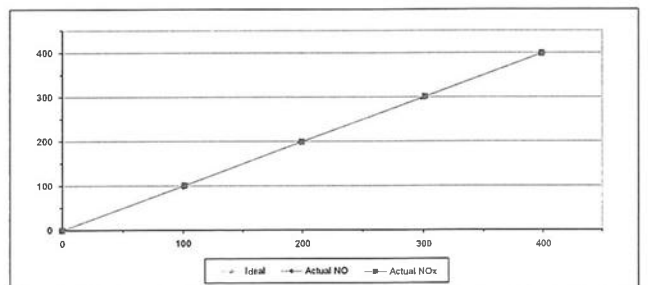
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jul-24 Equipment Name: NOx Analyzer
Manufacturer: HORIBA Model: APNA-370
Serial No.: NV0ER3YH Equipment ID: RYG_FS0459
Calibrator Manufacturer: Teledyne API Model: 700
Serial No.: 947
Std. Gas Concentration (PPM): 55.88 Cylinder No.: GN0027222
Cylinder Pressure (psi): 1800 Certified By: Airgas Inc.
Certified Date: 8-Feb-22 Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.20	1.20	1.20
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.40	1.40	0.47
4	400.00	400.30	0.30	0.08	398.80	-1.20	-0.30
AVERAGE (%)				-0.13			0.26



Calibrated By

Approved By

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

(Mr. Sarayuth Jitranont)
Assistant General Manager

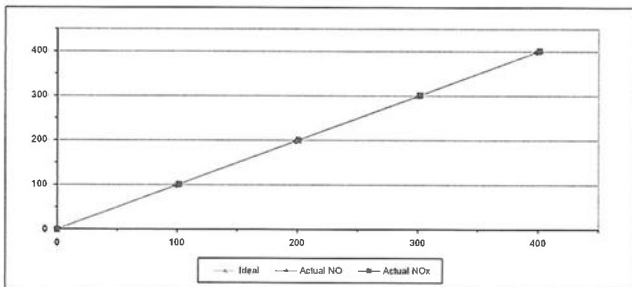
ALS Laboratory Group
FORM NO: F 06-056 REVISION NO:1 ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	ALP0V0WY	Equipment ID	RYG_FS0455
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psf)	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	98.60	-1.40	-1.40	101.60	1.60	1.60
2	200.00	198.80	-1.20	-0.60	201.30	1.30	0.65
3	300.00	301.00	1.00	0.33	301.80	1.80	0.60
4	400.00	398.50	-1.50	-0.38	401.30	1.30	0.33
AVERAGE (%)				-0.39			0.86



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

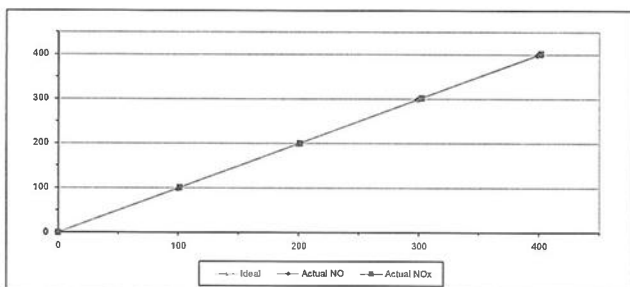
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	R06K0177	Equipment ID	RYG_FS0463
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psf)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	101.30	1.30	1.30
2	200.00	201.30	1.30	0.65	201.20	1.20	0.60
3	300.00	299.40	-0.60	-0.20	302.60	2.60	0.87
4	400.00	398.70	-1.30	-0.33	401.50	1.50	0.38
AVERAGE (%)				-0.20			0.65



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

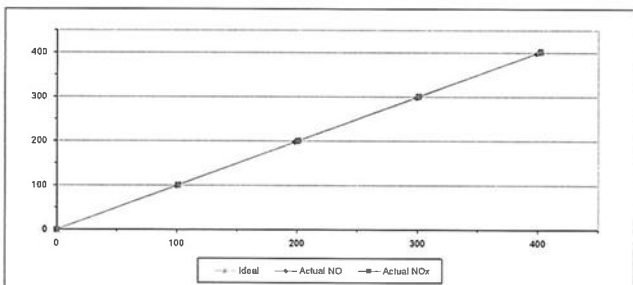
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	7239	Equipment ID	RYG_FS0535
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psf)	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	99.80	-0.20	-0.20	101.00	1.00	1.00
2	200.00	198.30	-1.70	-0.85	201.20	1.20	0.65
3	300.00	298.80	-1.20	-0.40	301.30	1.30	0.40
4	400.00	398.70	-1.30	-0.33	402.30	2.30	0.58
AVERAGE (%)				-0.33			0.55



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

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



Jirawat Associates Co., Ltd.
67/111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-155115 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

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 are as follows:

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITIONS

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Sarawit Thummalak

Miss Jiraporn Jantachai

Remarks:

No file intersection area of the wind tunnel

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

Diameter of mounting pipe

Sign: [Signature]

Cup anemometer

Novatex

Sensor: WS-02FA

Data logger: T10 WS-250LD

Sensor: WSD-A5580

Data logger: AS580

RYG_FS0548

New Item

ALS laboratory group (Thailand) Co., Ltd

104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

16 Jun 2023

10 Jun 2023

20 Jun 2023

23.0 ± 3.0 °C

55.0 ± 15.0 %RH

1010 ± 1.0 hPa

Effel type wind tunnel of Jirawat Associates Co., Ltd.

Wind tunnel cross-section area

Win direction front area

Diameter of mounting pipe

Blockage ratio of test object

900 cm²

100 cm²

-

0.111 [-]

24 hours at ambient conditions

(The average values during measurement are (24.4) °C, (45.6) %RH and (1011.5) hPa.

Calibration procedure:

The cup anemometer was calibrated against

Standard air velocity transducer model: 8-153-32

and also tube with precision differential pressure

meter model: DPM2500 in an open left-section of

Effel-type wind tunnel with 500 cm² cross test

section area. The WCL 007 basic is 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 national

standards and to realization of the international

system of units (SI) through the NIMT (National

Metrology Institute of Thailand) via Certificate

Number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:

The reported uncertainty of measurement is

based on the standard uncertainty multiplied by a

coverage factor k=2. When 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

Mr. Pinyas Jantachai

Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: V1920214,

Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20,057	20,0	-0,1	0,099
70	25,051	24,9	0,2	0,099
70	30,044	29,8	-0,2	0,099
70	35,039	34,8	0,2	0,099
70	40,034	39,7	-0,3	0,099

UUC* : Unit Under Calibration

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Calibration No.: RH-08062023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger

Manufacturer : Novatek

Model/Type : 110-WS-25DL-D

Serial Number : A5980

ID No. : RYG-FS0649

Customer : ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang, Khel Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860-3 in the humidity generator chamber to determine the error.

Traceability:

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926-001, Due date: Sep 24, 2024.

Measurement Date : Jun 20, 2023

Issued Date : Jun 22, 2023

Measurement Results:

This equipment was connected with indoor air quality probe and Displayed (URI) on display, Model: HMP60, Serial number: V1920214.

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.04	19.3	-0.7	0.62
50	50.26	49.6	-0.8	0.62
80	80.33	80.5	0.2	0.62

Performed by

- ☒ Mr. Sorawit Thachetel
☒ Miss Jitraporn Lertsamphol
☐ Miss Ruengrumpai Phoommit



Approved Signatory:

Mr. Parinye Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Certificate No.: CP-009-66

Page 2 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Digital barometer
Novatek
Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D

SERIAL NUMBER

Sensor: JP-A5980
Data logger: A5980
RYG-FS0649

ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Novatek
ALS laboratory group (Thailand) Co., Ltd
104 Phatthanasak 40, Phatthanasak Rd,
Khwaeng Suan Luang, Khel Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

16 Jun 2023
20 Jun 2023
20 Jun 2023

Calibration procedure:

The pressure calibration was done by in-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-P 6.2

Traceability:

The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP 0205-22

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0205-22	02 Dec 2023

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level
3. Calibration conditions:

4. Condition
Pressure transmitting medium: ☒ Normal ☐ Abnormal
Air
P (20°C, 1 bar): 1.15 kg/m²
H₂O: (55±7) %
T_{amb}: (23±3) °C
P_{max}: (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
22 Mr. Sorawit Thachetel
☒ Miss Jitraporn Lertsamphol



Approved signatory

Mr. Parinye Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No.: CP-009-66

Page 2 of 2 Pages

MEASUREMENT RESULTS

☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 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)
950.13	950.8	0.6	0.44
970.04	970.4	0.4	0.60
990.10	990.3	0.2	0.46
1010.08	1010.1	0.0	0.37
1030.10	1029.8	-0.3	0.50
1050.09	1049.5	-0.5	0.75

Note: UUC* Unit Under Calibration

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

End of certificate



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 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
1.024	23.84	23.95	0.8	-0.2	0.31
2.079	24.08	23.95	1.8	-0.3	0.31
3.019	24.04	23.95	2.8	-0.2	0.31
4.150	24.12	23.95	3.9	-0.3	0.31
5.00	23.72	23.95	4.8	-0.2	0.31
5.99	23.89	23.95	5.8	-0.2	0.31
7.04	23.68	23.95	6.9	-0.2	0.31
8.15	23.64	23.95	7.9	-0.2	0.31
9.09	23.30	23.95	9.0	-0.1	0.31
10.05	23.40	23.95	9.9	-0.1	0.31
11.13	23.48	23.95	11.0	-0.2	0.31
12.11	23.40	23.95	12.0	-0.1	0.31
13.16	23.50	23.95	13.0	-0.1	0.31
14.22	23.40	23.95	14.0	-0.2	0.31
15.22	23.50	23.95	15.0	-0.2	0.31
16.27	23.44	23.95	16.1	-0.2	0.31

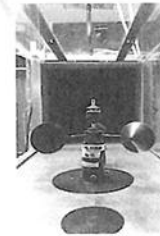
Remark:

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.



MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Cup anemometer
Novolyte
Sensor: WS-02F
Data logger: 110 WS-25DL-D
Sensor: WSD-A5662
Data logger: AS662
RVC_230544
Used: com
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: B455-42 and pitot tube with precision differential pressure meter model: DPA-15200 in an air speed test section area. The WCL 007 based on IEC 61400-17-1, Wind energy generation systems - Part 17-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

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

Uncertainty of Measurement:

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

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 1.0 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹: 900 cm²
Wind 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 (24.0) °C, (41.7) %RH and (1005.1) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thairakul
Miss Jiraporn Lertsakulchai



Approved signatory

[Signature]
Mr. Jiraporn Lertsakulchai
Calibration Department Manager

Remark:

¹ Available 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 to S.

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

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.

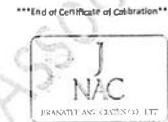
Air speed m/s	D _{ref} Degree (°)	D _{uuc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
	180.000	180	0	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0
	360.000	359	-1	1.0

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.



MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Wind Direction Sensor
Novolyte
Sensor: WS-02F
Data logger: 110 WS-25DL-D
Sensor: WSD-A5662
Data logger: AS662
RVC_230544
Used: com
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AR40075-D404-PI 540 in an air speed test section area. The WCL 008 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standard, and to recognition of the international system of units (SI) through the NMVT (National Metrology Institute of Thailand) via Certificate number: DA-003-22.

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".

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 1.0 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹: 900 cm²
Wind direction frontal area²: 129 cm²
Diameter of mounting pipe³: - mm
Blockage ratio of test object⁴: 0.148 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions

The average values during measurement are (23.0) °C, (43.0) %RH and (1011.6) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thairakul
Miss Jiraporn Lertsakulchai



Approved signatory

[Signature]
Mr. Jiraporn Lertsakulchai
Calibration Department Manager

Remark:

¹ Available 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 to S.

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.: CDT-037-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novatym
Model: 110-WS-25DL-D
Serial No.: A5662
ID No.: RYG_FS0544

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

Received date: 11 Jul 2023
Calibration date: 21 Jul 2023
Issue date: 21 Jul 2023

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023

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

Calibration Procedure

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

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0038 23, Certificate number: ER-0092-
22

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

Calibrated by

☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Calibration No.: RH-01072023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novatym
Model/Type: 110-WS-25DL-D
Serial Number: A5662
ID No.: RYG_FS0544
Customer: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwang Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±16)%.

Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model, 1660-3 in the humidity generator chamber to determine the errors.

Traceability

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) by MCS Calibration, Inc. Certificate number: 20926-6D1, Due date: Sep 26, 2024.

Measurement Date: Jul 21, 2023
Issued Date: Jul 21, 2023

Measurement Results:

This equipment was connected with indoor air quality probe and Displayed (UH) on display. Model: HMP60, Serial number: T2320391.

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	20.07	16.3	-3.8	0.61
50	50.23	45.0	-5.2	0.61
80	80.23	73.5	-6.7	0.61

Performed by

☒ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Jiranatee Associate Co., Ltd.
63/14-15, 67/35-36,
Petchkasem 7/7/1, Petchkasem Rd,
Bangkok 10600 Thailand
Tel: +66(0)2-8680812
E-mail: info@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-17515:2023
CALIBRATION 0167

Air speed measurement laboratory
Calibration services department

NSC-TIS-TIS 17025
CALIBRATION 0367

Certificate Number

CWS 036-67

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 are as follow:

Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 100.0 ± 10 hPa

PLACE OF CALIBRATION

1. Office type wind tunnel of Jiranatee Associate Co., Ltd.

CALIBRATION CONDITIONS

1. Wind tunnel cross-section area: 900 cm²
2. Wind direction (spiral area): 100 cm²
3. Diameter of nozzle (spiral pipe): - mm
4. Blockage ratio of test object: 0.111 [-]

Preconditioning

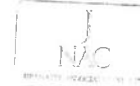
Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thachalad
Miss Jitraporn Lertsomphol



Approved Signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

- 1. Measure cross-section area of the wind to test
- 2. Projected cross-section area of the tested object include mounting pipe
- 3. Flow rate of the wind machine
- 4. Refer to

Calibration procedure:

The Cup anemometer was calibrated against
Standard air velocity transducer model: 8650-22
and pitot tube with pressure difference pressure
meter model: 3PM2500 in an air test section of
F501 type wind tunnel with 300 km/h cross test
section area. The WGL 867 Series is IEC 61450-
22-2, Wind energy generation systems - Part 22-
2, Power performance measurements of
electricity producing wind turbines, March 2022
was used as a calibration guideline.

Traceability

This certificate provides a traceability of the
measurement to recognized the national
standards, and to realization of the international
system of units (SI) through the NIMT (National
Institute of Metrology of Thailand) via Certificate
number: MN-0007-24 and NM-0555-23

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".

REVIEW BY:

APPROVED BY:

NEXT CAL DATE: 5/18/26

Certificate Number
CWS-036-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Uni 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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with pressure differential pressure reader which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a room vertical axis at the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s at 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_{meas} (m/s)	Error (m/s)	$U(95\%)$ (m/s)
1.007	24.10	23.90	0.9	-0.1	0.31
2.054	23.72	23.90	1.9	0.2	0.31
2.991	24.02	23.90	2.9	-0.1	0.31
4.093	24.04	23.90	3.9	0.2	0.31
4.98	23.70	23.90	5.0	0.0	0.31
6.02	23.60	23.90	6.0	0.0	0.31
7.03	23.70	23.90	7.1	0.1	0.31
7.98	23.58	23.90	8.1	0.1	0.31
8.99	23.70	23.90	9.1	0.1	0.31
9.97	23.50	23.90	10.1	0.1	0.31
10.96	23.78	23.90	11.2	0.2	0.31
12.05	23.50	23.90	12.2	0.2	0.31
12.97	23.60	23.90	13.3	0.3	0.31
14.03	23.56	23.90	14.4	0.3	0.31
15.03	23.80	23.90	15.3	0.3	0.31
16.02	23.72	23.90	16.3	0.3	0.31

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 Uni 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. Remarks: The proportion of the set-up is not true to scale due to imaging geometry.



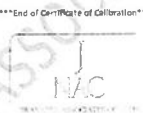
Page 2 of 2 Pages

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 counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D _{meas} Degree (°)	D _{ref} Degree (°)	Error Degree (°)	U(95%) Degree (°)
	0.000	0	0	0.80
	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	133	-2	0.80
	180.000	180	0	0.80
	225.000	227	2	0.80
	270.000	273	3	0.80
	315.000	318	3	0.80

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 Uni Under Calibration.



Calibrated by:
 1. Mr. Sornchai Thirapong
 2. Mr. Jirapong Lertsomphol
 3. Mr. Jirapong Lertsomphol

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Wind Direction Sensor

MANUFACTURER

Navalyn

MODEL/TYPE

Sensor WS-02F

SERIAL NUMBER

Data logger: 110 WS-250L-D

ID NUMBER

Sensor WS0-AS789

CONDITION AS-RECEIVED

Data logger: AS789

CUSTOMER

Used item
 : AIS Laboratory group (Thailand) Co., Ltd.
 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang,
 Khru Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

08 Aug 2024

MEASUREMENT DATE

28 Aug 2024

ISSUE DATE

28 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature : 23.0 ± 3.0 °C
 Relative Humidity : 55.0 ± 15.0 %RH
 Atmospheric Pressure : 101.0 ± 3.0 hPa

PLACE OF CALIBRATION

Effect-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ : 500 cm²
 Wind direction from wind tunnel : 129 cm²
 Diameter of measuring pipe² : 129 mm
 Blockage ratio of test object³ : 0.343

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are 23.8°C, 60.0 %RH and 100.5 hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
 1. Mr. Sornchai Thirapong
 2. Mr. Jirapong Lertsomphol



Approved signatory
 Mr. Panyai Booncharoen
 Calibration Department Manager

Remarks:
¹ Range : cross-section area of the wind tunnel
² Provided : cross-section area of the tested object on the measuring pipe
³ Diameter of measuring pipe
⁴ Ratio : 100%

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CERTIFICATE OF CALIBRATION

Certificate No. : CDT-163-67

Page 1 of 2 Pages

MEASUREMENT ITEM

Data Logger with Temperature sensor

MANUFACTURER

Navalyn

MODEL/TYPE

110 WS-250L-D

SERIAL NUMBER

AS789

ID NUMBER

RYG-150531

CONDITION AS-RECEIVED

Used item

CUSTOMER

: AIS Laboratory group (Thailand) Co., Ltd.
 104 Phatthanakan 40, Phatthanakan Rd.,
 Khwaeng Suan Luang, Khru Suan Luang,
 Bangkok 10250 Thailand.

RECEIVED DATE

08 Aug 2024

MEASUREMENT DATE

28 Aug 2024

ISSUE DATE

28 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow

Temperature : 23.0 ± 3.0 °C
 Relative Humidity : 55.0 ± 15.0 %RH

NOTED: The certificate is valid only to the item calibrated on date and place of calibration

TABULATION OF RESULTS:

The table on next page give the measured values

Calibration procedure:

The temperature calibration was done by in house calibration method by WS-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: 11-0047-24, Certificate number: ER 0101-23

Reference Used During Calibration:

1. Standard Temperature Probe
 Model: STS-100 AS00, Serial No.: 16751-2-05,
 Due date: 16 Mar 2025
 2. Digital Temperature Indicator
 Model: DTI-1000 A.M.K.II, Serial No.: w7407,
 Due date: 14 Sep 2024

Uncertainty of Measurement:

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

Calibrated by:
 1. Mr. Sornchai Thirapong
 2. Mr. Jirapong Lertsomphol
 3. Mr. Jirapong Lertsomphol



Approved signatory
 Mr. Panyai Booncharoen
 Calibration Department Manager

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Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function: Table 3: This equipment was connected with temperature sensor Model: HMP60 5/N: T0210901, Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.049	19.6	-0.4	0.099
80	25.053	24.6	-0.5	0.099
80	30.044	29.7	-0.3	0.099
80	35.027	34.5	-0.5	0.099
80	40.019	39.5	-0.5	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



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

Relative humidity and Air Temperature measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-033-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Navalyte
MODEL/TYPE : Data Logger: 110-WS-250L-D
Sensor: HMP60
SERIAL NUMBER : Data Logger: A5786
Sensor: T0210901
ID NUMBER : RVG_F50313
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 25 Aug 2024
ISSUE DATE : 25 Aug 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

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

Calibration procedure:
The Relative humidity and Air Temperature calibration was done by in-house calibration method as WI CL 029 and WI CL 010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

Traceability:
The measurement is traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TH-019-23 and through standard Agreement Co., Ltd. Certificate number: CDT 021-67

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

Calibrated by:
☐ Mr. Sornwan Thuchalad
☒ Mr. Nitiraporn Lertsomphol
☐ Mr. Nungpraporn Phoomthi



Approved signature: Mr. Panyra 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

Measurement Results:

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below
Calibration Range: 20%RH to 80%RH

Air Temperature (°C)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
29.82	59.61	57.9	-1.7	0.83
29.88	59.70	57.5	-2.2	1.3
29.91	62.37	57.6	-4.8	2.3

UUC*: Unit Under Calibration

End of Certificate of Calibration



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

Air speed measurement laboratory
Calibration services department.



NSC - TIS - TIS 17025
CALIBRATION 0367

Certificate Number

CWS-030-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Navalyte
MODEL/TYPE : Sensor: WS-028
Data logger: WS-250L
Sensor: WS0-A054D
SERIAL NUMBER : Data Logger: A4552
ID NUMBER : RVG_F50313
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 20 Aug 2024
ISSUE DATE : 20 Aug 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1009.4 ± 1.0 hPa

PLACE OF CALIBRATION : 11m type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS:
Wind tunnel cross-section area: 900 cm²
Wind direction horizontal area: 100 cm²
Diameter of mounting pipe: 1 mm
Blockage ratio of test object: 0.11 [-]

Preconditioning: 24 hours at sea level conditions.
Measurement Condition: The average values during measurement are (24.3) °C, (41.9) %RH and (1007.9) hPa

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

Calibrated by:
☒ Mr. Sornwan Thuchalad
☐ Mr. Nitiraporn Lertsomphol



Approved signature: Mr. Panyra Booncharoen
Calibration Department Manager

Remarks:
1. Actual cross section area of the wind tunnel
2. Proposed cross section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Ratio: 10

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: B455-32 and pitot tube with pressure coefficient: pressure meter model: THM2500 in an open section of 11m type wind tunnel with 500 mm cross test section area. The WS-C1-040 base in REC 61400-12-5, Wind energy generator type: 11m 12-2. Power performance measurements of electricity producing wind turbines, March 2017 was used as a reference.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards used for realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: TH-019-23 and MIA-005-23

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".

REVIEW BY: [Signature]
APPROVED BY: [Signature]
NEXT CAL DATE: 20/2/26

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



Lot No. 24118721-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf JP NLL Co., Ltd. Location : Ulae HRSG 11
Date : 25 Oct 24 Test Operator : Sakitt P.

O₂ ANALYZER
Cylinder Conc. (%) : 16.02

Span (%) : 25

	O ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.10	0.10	0.00	0.05	0.20	0.20
Upscale Gas	16.12	16.12	0.00	16.07	0.20	0.20

NO_x ANALYZER
Cylinder Conc. (ppm) : 164.40

Span (ppm) : 200

	NO _x Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.35	0.35	0.00	0.10	0.13	0.13
Upscale Gas	164.75	164.75	0.00	164.50	0.13	0.13

SO₂ ANALYZER
Cylinder Conc. (ppm) : 159.90

Span (ppm) : 200

	SO ₂ Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.03	-0.06	0.02	-0.01	0.01	0.03
Upscale Gas	159.87	159.84	0.02	159.89	0.01	0.02

CO ANALYZER
Cylinder Conc. (ppm) : 407.40

Span (ppm) : 500

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	-0.05	-0.05	0.00	-0.01	0.01	0.01
Upscale Gas	407.35	407.35	0.00	407.39	0.01	0.01

Calibrated by

(Mr. Sakitt Phalanphitout)

Environmental Field Scientist (4)

FORM NO. F 06-063 REVISION NO. 4 ISSUE DATE 18/01/24

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf JP NLL Co., Ltd.
Date : 25 Oct 24
Start Time : 10:30
SO₂ Analyzer Model : TELEDYNE API 100EH
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH
CO/CO₂ Analyzer Model : TELEDYNE API 300EM

Run # : 1
Location : Ulae HRSG 11
Test Operator : Sakitt P.
Finish Time : 10:50
Serial No. : 437
Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:30	14.14	3.87	11.34	0.09	0.14	
10:31	14.13	3.88	11.50	0.09	0.19	
10:32	14.11	3.89	11.65	0.09	0.20	
10:33	14.11	3.87	11.73	0.13	0.17	
10:34	14.11	3.88	11.71	0.12	0.17	
10:35	14.10	3.88	11.69	0.11	0.15	
10:36	14.10	3.88	11.70	0.11	0.21	
10:37	14.10	3.88	11.75	0.09	0.20	
10:38	14.11	3.89	11.77	0.09	0.21	
10:39	14.11	3.88	11.81	0.12	0.20	
10:40	14.12	3.88	11.79	0.10	0.19	
10:41	14.09	3.88	11.91	0.12	0.29	
10:42	14.09	3.88	11.98	0.11	0.26	
10:43	14.10	3.88	11.99	0.10	0.23	
10:44	14.10	3.88	11.97	0.14	0.28	
10:45	14.10	3.88	12.07	0.14	0.28	
10:46	14.12	3.87	12.10	0.13	0.26	
10:47	14.10	3.88	12.00	0.12	0.27	
10:48	14.09	3.89	12.00	0.13	0.27	
10:49	14.09	3.90	12.05	0.14	0.26	
10:50	14.08	3.92	12.03	0.11	0.26	
Average	14.10	3.88	11.83	0.11	0.23	

(Mr. Sakitt Phalanphitout)

Environmental Field Scientist (4)

FORM NO. F 06-060 REVISION NO. 1 ISSUE DATE 18/01/24

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf JP NLL Co., Ltd. Run # : 2
Date : 25 Oct 24 Location : Ulae HRSG 11
Start Time : 10:51 Test Operator : Sakitt P.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:11
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 437
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:51	14.07	3.89	12.03	0.12	0.25	
10:52	14.08	3.89	12.08	0.12	0.25	
10:53	14.09	3.89	12.08	0.14	0.29	
10:54	14.08	3.89	11.98	0.13	0.28	
10:55	14.07	3.89	11.99	0.16	0.30	
10:56	14.09	3.89	12.02	0.10	0.31	
10:57	14.09	3.88	12.08	0.12	0.29	
10:58	14.10	3.87	12.05	0.11	0.21	
10:59	14.10	3.90	11.88	0.10	0.18	
11:00	14.09	3.90	11.96	0.08	0.15	
11:01	14.09	3.89	11.96	0.14	0.16	
11:02	14.08	3.89	12.01	0.09	0.20	
11:03	14.08	3.88	12.06	0.11	0.17	
11:04	14.10	3.89	11.84	0.13	0.13	
11:05	14.10	3.89	11.84	0.13	0.12	
11:06	14.10	3.88	11.72	0.11	0.13	
11:07	14.08	3.88	11.87	0.13	0.14	
11:08	14.08	3.87	11.96	0.12	0.14	
11:09	14.08	3.88	11.98	0.08	0.16	
11:10	14.08	3.88	12.08	0.08	0.21	
11:11	14.08	3.89	12.05	0.09	0.14	
Average	14.08	3.88	11.88	0.11	0.20	

(Mr. Sakitt Phalanphitout)

Environmental Field Scientist (4)

FORM NO. F 06-060 REVISION NO. 1 ISSUE DATE 18/01/24

ALS Laboratory Group



EMISSION TEST RESULT

Client : Gulf JP NLL Co., Ltd.
Date : 25 Oct 24
Start Time : 11:12
SO₂ Analyzer Model : TELEDYNE API 100EH
NO_x/O₂ Analyzer Model : TELEDYNE API 200EH
CO/CO₂ Analyzer Model : TELEDYNE API 300EM

Run # : 3
Location : Ulae HRSG 11
Test Operator : Sakitt P.
Finish Time : 11:32
Serial No. : 437
Serial No. : 774
Serial No. : 451

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:12	14.09	3.88	12.08	0.10	0.20	
11:13	14.10	3.87	11.96	0.10	0.22	
11:14	14.11	3.87	12.01	0.11	0.15	
11:15	14.11	3.87	12.15	0.12	0.29	
11:16	14.10	3.89	12.17	0.12	0.26	
11:17	14.08	3.89	12.15	0.13	0.27	
11:18	14.08	3.90	12.11	0.14	0.33	
11:19	14.08	3.89	12.07	0.14	0.26	
11:20	14.08	3.89	12.05	0.15	0.27	
11:21	14.08	3.89	12.15	0.12	0.27	
11:22	14.09	3.88	12.09	0.10	0.30	
11:23	14.07	3.88	12.06	0.09	0.31	
11:24	14.08	3.87	11.99	0.09	0.26	
11:25	14.11	3.86	11.99	0.10	0.27	
11:26	14.11	3.86	12.00	0.11	0.30	
11:27	14.12	3.86	12.02	0.08	0.27	
11:28	14.11	3.87	12.13	0.09	0.27	
11:29	14.12	3.86	12.20	0.09	0.27	
11:30	14.11	3.86	12.14	0.10	0.27	
11:31	14.10	3.86	12.15	0.11	0.27	
11:32	14.10	3.86	12.14	0.11	0.25	
Average	14.09	3.87	12.08	0.10	0.26	

(Mr. Sakitt Phalanphitout)

Environmental Field Scientist (4)

FORM NO. F 06-060 REVISION NO. 1 ISSUE DATE 18/01/24

ALS Laboratory Group



Lot No. 24118727-1

ANALYZER CALIBRATION DATA

Client : Gulf JP NLL Co., Ltd. Location : Ulae HRSG 12
Date : 25 Oct 24 Test Operator : Sathaporn T.O₂ ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.01	0.00
Low-Level Gas	8.19	8.20	8.22	0.08
Span Gas	16.07	16.08	16.09	0.04

NO₂ ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.01
Low-Level Gas	84.96	84.95	84.95	0.00
Span Gas	82.51	82.50	82.48	0.02

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.00	0.00
Low-Level Gas	55.55	55.53	55.53	0.00
Span Gas	79.76	79.75	79.74	0.01

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

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.01
Low-Level Gas	54.94	54.82	54.81	0.01
Span Gas	79.74	79.74	79.73	0.01

Calibrated by

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-002 REVISION NO. 4 ISSUE DATE 18/01/24
ALS Laboratory Group

Lot No. 24118727-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf JP NLL Co., Ltd. Location : Ulae HRSG 12
Date : 25 Oct 24 Test Operator : Sathaporn T.O₂ ANALYZER
Cylinder Conc. (%) : 16.07 Span (%) : 25

	O ₂ Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.02	0.04	0.02	0.02	0.04	0.04	0.00
Upscale Gas	16.08	16.12	0.16	16.12	0.16	0.16	0.00	0.00

NO₂ ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO ₂ Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.03	0.02	0.03	0.03	0.02	0.00	0.00
Upscale Gas	82.50	82.45	0.05	82.45	0.05	0.05	0.00	0.00

SO₂ ANALYZER
Cylinder Conc. (ppm) : 79.76 Span (ppm) : 100

	SO ₂ Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upscale Gas	79.75	79.72	0.03	79.72	0.03	0.03	0.00	0.00

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

	CO Analyzer Calibration Response	Initial Values	System Calibration Response	System Cal Bias (% of Span)	Final Values	System Calibration Response	System Cal Bias (% of Span)	Drift (% of Span)
Zero Gas	0.01	0.02	0.01	0.02	0.02	0.01	0.00	0.00
Upscale Gas	79.74	79.70	0.04	79.70	0.04	0.04	0.00	0.00

Calibrated by

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-003 REVISION NO. 4 ISSUE DATE 18/01/24
ALS Laboratory Group

EMISSION TEST RESULT

Client : Gulf JP NLL Co., Ltd. Run # : 1
Date : 25 Oct 24 Location : Ulae HRSG 12
Start Time : 10:50 Test Operator : Sathaporn T.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:10
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 410
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 735
Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
10:50	13.95	3.19	11.97	0.04	3.46	
10:51	13.95	4.00	11.95	0.02	3.43	
10:52	14.23	3.98	12.22	0.02	3.41	
10:53	14.23	3.13	12.18	0.05	3.31	
10:54	14.23	3.58	12.29	0.01	3.29	
10:55	14.37	4.00	12.57	0.04	3.24	
10:56	14.39	3.94	12.60	0.03	3.24	
10:57	14.39	3.95	12.14	0.03	3.30	
10:58	14.38	3.63	13.79	0.02	3.22	
10:59	14.37	3.97	13.90	0.02	3.28	
11:00	14.38	3.97	13.77	0.04	3.21	
11:01	14.37	3.97	13.69	0.05	3.18	
11:02	14.36	3.97	13.77	0.04	3.17	
11:03	14.36	3.94	13.73	0.04	3.13	
11:04	14.38	3.96	13.66	0.04	3.17	
11:05	14.38	3.97	13.65	0.03	3.14	
11:06	14.38	3.99	13.71	0.04	3.11	
11:07	14.38	4.00	13.72	0.02	3.09	
11:08	14.37	3.93	13.79	0.03	3.04	
11:09	14.37	3.97	13.91	0.00	2.97	
11:10	14.37	3.96	13.94	0.02	2.98	
Average	14.32	3.97	13.26	0.03	3.21	

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-003 REVISION NO. 1 ISSUE DATE 18/01/24
ALS Laboratory Group

EMISSION TEST RESULT

Client : Gulf JP NLL Co., Ltd. Run # : 2
Date : 25 Oct 24 Location : Ulae HRSG 12
Start Time : 11:11 Test Operator : Sathaporn T.
SO₂ Analyzer Model : TELEDYNE API 100EH Finish Time : 11:31
NO₂/O₂ Analyzer Model : TELEDYNE API 200EH Serial No. : 410
CO/CO₂ Analyzer Model : TELEDYNE API 300EM Serial No. : 735
Serial No. : 425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:11	14.36	3.97	13.64	0.04	3.04	
11:12	14.39	3.98	13.70	0.02	2.96	
11:13	14.38	3.95	13.43	0.01	2.93	
11:14	14.39	3.96	13.99	0.05	2.85	
11:15	14.38	3.99	14.00	0.02	2.86	
11:16	14.38	3.93	13.93	0.03	2.92	
11:17	14.37	3.99	13.88	0.03	2.86	
11:18	14.37	3.94	13.79	0.02	2.85	
11:19	14.37	3.96	13.66	0.04	2.86	
11:20	14.38	3.95	13.68	0.05	2.77	
11:21	14.39	3.97	13.70	0.05	2.75	
11:22	14.38	3.95	13.82	0.03	2.71	
11:23	14.39	3.94	13.60	0.03	2.74	
11:24	14.39	3.97	13.97	0.07	2.74	
11:25	14.38	3.93	14.10	0.03	2.68	
11:26	14.40	3.94	14.11	0.04	2.66	
11:27	14.39	3.94	14.15	0.05	2.71	
11:28	14.40	3.97	14.19	0.03	2.65	
11:29	14.40	3.97	14.18	0.07	2.59	
11:30	14.39	3.93	14.14	0.01	2.70	
11:31	14.40	3.97	14.13	0.01	2.67	
Average	14.39	3.96	13.93	0.03	2.79	

Sathaporn.T

(Mr.Sathaporn Thakaw)

Environmental Field Scientist (3)

FORM NO. F-06-003 REVISION NO. 1 ISSUE DATE 18/01/24
ALS Laboratory Group



EMISSION TEST RESULT

Client	Gulf J.P. MLL Co., Ltd.	Run #	3
Date	25 Oct 24	Location	Slide HR50 12
Start Time	11:32	Test Operator	Sathaporn T.
SO ₂ Analyzer Model	TELEDYNE API 100EH	Finish Time	11:52
NO _x /O ₂ Analyzer Model	TELEDYNE API 200EH	Serial No.	410
CO/CO ₂ Analyzer Model	TELEDYNE API 300EH	Serial No.	735
		Serial No.	425

Time (min)	O ₂ (%)	CO ₂ (%)	NO _x (ppm)	SO ₂ (ppm)	CO (ppm)	Remark
11:32	14.39	3.94	14.07	0.04	2.69	
11:33	14.39	3.96	14.00	0.02	2.71	
11:34	14.38	3.93	13.90	0.02	2.69	
11:35	14.38	3.97	13.83	0.05	2.69	
11:36	14.37	3.97	13.84	0.03	2.66	
11:37	14.37	3.96	13.84	0.04	2.64	
11:38	14.37	3.97	13.92	0.04	2.67	
11:39	14.36	3.95	13.97	0.04	2.62	
11:40	14.36	3.97	14.04	0.03	2.60	
11:41	14.35	3.96	13.96	0.04	2.59	
11:42	14.37	4.00	13.93	0.03	2.58	
11:43	14.38	3.95	13.88	0.03	2.59	
11:44	14.38	3.98	13.86	0.03	2.57	
11:45	14.38	3.98	13.90	0.03	2.54	
11:46	14.37	3.94	13.92	0.03	2.58	
11:47	14.37	3.93	13.94	0.02	2.61	
11:48	14.37	3.98	13.91	0.02	2.55	
11:49	14.37	3.95	13.93	0.02	2.48	
11:50	14.35	3.95	13.93	0.02	2.51	
11:51	14.34	3.95	13.83	0.03	2.61	
11:52	14.34	3.99	13.76	0.04	2.54	
Average	14.37	3.96	13.91	0.03	2.61	

Sathaporn T.

(Mr. Sathaporn Thakorn)

Environmental Field Scientist (3)



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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	AIR LIQUIDE (THAILAND) LTD E04NI99E3HA0002	Reference Number:	160-402340013-1
Part Number:	GN0027210	Cylinder Volume:	247.2 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2215 PSIG
PGVP Number:	A12022	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Feb 11, 2022

Expiration Date: Feb 11, 2030

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

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.39 PPM	G1	+/- 1.1% NIST Traceable	02/04/2022, 02/11/2022
CARBON MONOXIDE	80.00 PPM	78.48 PPM	G1	+/- 0.8% NIST Traceable	02/04/2022
NITRIC OXIDE	80.00 PPM	82.36 PPM	G1	+/- 1.0% NIST Traceable	02/04/2022, 02/11/2022
SULFUR DIOXIDE	80.00 PPM	78.75 PPM	G1	+/- 0.9% NIST Traceable	02/04/2022, 02/11/2022
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09010212	KAL004777	98.48 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Oct 16, 2024
NTRM	200610-15	C0733106	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
NTRM	200610-04	C0708044	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124208M9139	C0323707	4.087 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Sep 03, 2024
NTRM	11010419	KAL004813	99.5 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Feb 03, 2022
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 10, 2022
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jan 27, 2022
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jan 20, 2022

Triad Data Available Upon Request

NOTES: Gross Weight: 48.5 Kg

Net Weight: 8.1 Kg



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A021C	Reference Number:	160-402020199-1
Cylinder Number:	CC709609	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Feb 22, 2021

Expiration Date: Feb 22, 2029

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

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.96 PPM	G1	+/- 1.4% NIST Traceable	02/15/2021, 02/22/2021
CARBON MONOXIDE	55.00 PPM	54.94 PPM	G1	+/- 0.7% NIST Traceable	07/15/2021
NITRIC OXIDE	55.00 PPM	54.69 PPM	G1	+/- 1.1% NIST Traceable	02/15/2021, 02/22/2021
SULFUR DIOXIDE	55.00 PPM	55.55 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021, 02/22/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14050753	CC434455	49.18 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Feb 13, 2026
PRM	12386	D68E025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200611-04	C0707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 0.1%	Feb 02, 2025
GMIS	124206869	C0323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Feb 04, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:
Gross Weight: 28.8 Kg
Net Weight: 4.8 Kg



Approved for Release



Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Cannonsville, NY 08077-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E3HA0026	Reference Number:	82-401257890-1
Cylinder Number:	ND62877	Cylinder Volume:	247.2 CF
Laboratory:	124 - Riverton (SAP) - NJ	Cylinder Pressure:	2215 PSIG
PGVP Number:	B52018	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Aug 07, 2018

Expiration Date: Aug 07, 2026

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

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
NITRIC OXIDE	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
SULFUR DIOXIDE	160.0 PPM	159.8 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018, 08/07/2018
CARBON MONOXIDE	160.0 PPM	164.4 PPM	G1	+/- 1.1% NIST Traceable	07/30/2018
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	17060241	E80079587	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	May 11, 2019
PRM	12368	S604118	28.89 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMIS	7040010104	C0503041	6.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	11010414	KAL004792	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 28, 2023
NTRM	15060538	CC453507	491.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Jan 08, 2021

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 CO	FTIR	Jul 18, 2018
Nicolet 6700 APW1100391 NO	FTIR	Jul 12, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 03, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 02, 2018

Triad Data Available Upon Request

NOTES:
Net weight: 8107 grams
Gross weight: 47690 grams



This calibration standard has been certified in accordance with the May 2012 EPA Traceability Document EPA 600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this document as being NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the Issuer.



TESTING CERT NO. 3082.05

Approved for Release

CERTIFICATE OF ANALYSIS **Grade of Product: EPA Protocol**

Part Number: E04N196E3HA0002 Reference Number: 160-402138465-1
Cylinder Number: ND11222 Cylinder Volume: 247.2 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2215 PSIG
PGVP Number: A12021 Valve Outlet: 590
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jul 15, 2021
Expiration Date: Jul 15, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	79.74 PPM	G1	+/- 0.3% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	79.78 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12385	D685025	8.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 26, 2020
NTRM	20010150	CC733426	99.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 09, 2028
GMS	12420889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	15010224	KAL005638	97.59 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
The SRM, PRM or RGM noted above is only in reference to the GMS used in the assay and not part of the analysis.					
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Nicoret ISSO FTIR AUP2010245 CO	FTIR		Jun 24, 2021		
Nicoret ISSO FTIR AUP2010245 NO	FTIR		Jul 01, 2021		
Nicoret ISSO FTIR AUP2010245 NO2	FTIR		Jun 30, 2021		
Nicoret ISSO FTIR AUP2010245 SO2	FTIR		Jul 09, 2021		

Triad Data Available Upon Request

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



Michael A. Vukobratovic
Approved for Release

Page 1 of 160-402138465-1

CERTIFICATE OF ANALYSIS **Grade of Product: EPA Protocol**

Part Number: E02N192E3HA0000 Reference Number: 82-401018725-1
Cylinder Number: ND60018 Cylinder Volume: 248.4 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2214 PSIG
PGVP Number: BS2017 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Oct 23, 2017
Expiration Date: Oct 23, 2025

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	8.003 %	G1	+/- 0.4% NIST Traceable	10/23/2017
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM/MS	89080208	CC262337	8.961 % OXYGEN/NITROGEN	+/- 0.3%	Nov 08, 2018
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Horiba MPA 510-O2-TTWMJ041	Paramagnetic		Sep 28, 2017		

Triad Data Available Upon Request

NOTES:
This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-800R-12/031. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 2000.02

D. Muen
Approved for Release

Page 1 of 82-401018725-1

CERTIFICATE OF ANALYSIS **Grade of Product: EPA PROTOCOL STANDARD**

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N184E3HA0001 Reference Number: 160-402340010-1
Cylinder Number: GN0027197 Cylinder Volume: 249.8 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12022 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Feb 02, 2022
Expiration Date: Feb 02, 2030

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.02 %	G1	+/- 0.4% NIST Traceable	02/02/2022
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010230	K005528	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Jan 27, 2022		

Triad Data Available Upon Request

NOTES: Gross Weight: 48.8 Kg
Net Weight: 8.2 Kg



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Approved for Release

Page 1 of 160-402340010-1

CERTIFICATE OF ANALYSIS **Grade of Product: EPA PROTOCOL STANDARD**

Customer: AIR LIQUIDE (THAILAND) LTD
Part Number: E02N184E3HA0001 Reference Number: 160-402830555-1
Cylinder Number: GN0029535 Cylinder Volume: 250.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12023 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Sep 05, 2023
Expiration Date: Sep 05, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the issuer. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.07 %	G1	+/- 0.4% NIST Traceable	09/05/2023
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010230	K005528	23.2 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC		Aug 16, 2023		

Triad Data Available Upon Request

NOTES: Gross Weight: 50.0 Kg
Net Weight: 8.4 Kg



Rita Sh...
Approved for Release

Page 1 of 1

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E02NI92E3HA0000 Reference Number: 160-401948144-1
Cylinder Number: GN0025086 Cylinder Volume: 248.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2214 PSIG
PGVP Number: A12020 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Nov 11, 2020

Expiration Date: Nov 11, 2028

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

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	8.186 %	G1	+/- 0.3% NIST Traceable	11/11/20
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010602	1038055	9.967 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

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

Triad Data Available Upon Request

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



Approved for Release

Page 1 of 160-401948144



CONSOL CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 10-Jul-24
Next Cal. Date : 10-Jan-25
Barometric Pressure (mmHg) : 749.1
Relative Humidity (%) : 46.2
Temperature (°C) : 33.8
Reference Dry Gas Meter Data
Reference Dry Gas Meter ID : BKK_FS1122
Serial No. : A2033240
Correction Factor (Y) : 0.9824
Next Calibration Date : 7-Nov-24
Console Control Meter Data
Calibration No. : C-100724-BKK_FS0556
Dry Gas Meter ID : BKK_FS0556
Serial No. : 1606041
Model No. : XC-572-V

ΔH (mmHg)	θ (mmHg)	Minutes	Reference Dry Gas Meter Calibration			Console Control : Drygas Meter			Dry Gas Meter Correction Factor	Office Calibration Factor	ΔAvg
			Final	Initial	Total	Final	Initial	Total			
15	11.75	150.00	0.00	150.00	25.0	30354.0	30350.0	148.00	30.0	0.995	46.5688
25	9.24	150.00	0.00	150.00	29.0	30369.0	30355.0	147.00	30.0	1.0033	43.8741
50	6.53	150.00	0.00	150.00	28.0	30384.0	30370.0	146.00	31.0	0.9974	43.6907
80	5.19	150.00	0.00	150.00	30.0	30399.0	30385.0	142.00	31.0	0.9749	44.4716
120	4.20	150.00	0.00	150.00	30.0	30414.0	30400.0	140.00	31.0	1.0009	43.6811
										Avg	43.6442

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

ΔAvg : Office pressure differential that equates to 21.24 in of air @ 25°C and 760 mm of mercury. mmH2O: tolerance for individual values ± 5.08 from average.

Prepared by: Saksi Phaisanphit

Calibrated by: Saksi Phaisanphit
(Mr. Saksi Phaisanphit)
RYG Field Service Scientist (1)

Approved by:

Nattapon Jengwarewong
(Mr. Nattapon Jengwarewong)
RYG Field Service Specialist (1)

FORM NO. F 06-027 REVISION NO. 2 ISSUE DATE 9 Feb 22



Stopwatch Calibration Test Report

Calibration Date : 10 Jul 24 Next Cal. Date : 10 Jan 25
Barometric Pressure (mmHg) : 749.1 Temperature (°C) : 33.8
Relative Humidity (%) : 46.2

Reference Stopwatch Data Console Control Meter Data
Stopwatch ID No. : RYG_FS0540 Dry Gas Meter No. : BKK_FS0556
Model : F808 Model : XC-572-V
Serial No. : E18061 Serial No. : 1606041
Calibration Date : 4 Jul 24
Certificate No. : E-2407022

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:03	5:00	3	0.00005
2	5:00:07	5:00	7	0.00012
3	5:00:07	5:00	7	0.00012
4	5:00:08	5:00	8	0.00013
5	5:00:05	5:00	5	0.00008
6	5:00:07	5:00	7	0.00012
7	5:00:06	5:00	6	0.00010
8	5:00:08	5:00	8	0.00013
9	5:00:08	5:00	8	0.00013
10	5:00:07	5:00	7	0.00012
			Average	0.00011
			SD	0.00003

Calibrate by: Saksi Phaisanphit Approved by: Nattapon Jengwarewong
Mr. Saksi Phaisanphit Mr. Nattapon Jengwarewong
RYG Field Service Scientist (4) RYG Field Service Specialist (1)

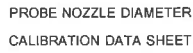


DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 10 Jul 24		Ambient Temperature (°C) 33.8			
Calibration sheet No. : C-100724-BKK_FS0557		Relative Humidity (%) : 46.2			
Digital Temperature ID : BKK_FS0557		Reference Temperature ID RYG_FS0601			
Serial No. : 1606041		Serial No. : 20100014918			
Model : XC-572-V		Model No. Digicon-CC-VT-MS			
Next Calibrate :		13 Nov 24			
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass
	100	99	-1	±3	Pass
	150	149	-1	±3	Pass
	200	199	-1	±3	Pass
	250	249	-1	±3	Pass
Probe	300	299	-1	±3	Pass
	500	499	-1	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
Oven	140	139	-1	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
Filter	140	141	1	±3	Pass
	0	0	0	±3	Pass
	10	10	0	±3	Pass
Exit	20	20	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
Meter	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	24	-1	±3	Pass
AUX	50	49	-1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดของเครื่องมือวัด

Calibrated by: Saksi Phaisanphit Approved by: Nattapon Jengwarewong
Mr. Saksi Phaisanphit Mr. Nattapon Jengwarewong
RYG Field Service Scientist (4) RYG Field Service Specialist (1)

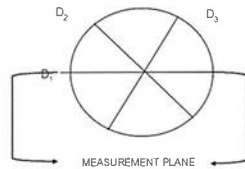


Where :

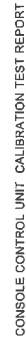
D_1, D_2, D_3 * There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm

ΔD * Maximum distance between any two diameters, must be ≤ 0.100 mm,

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



Approved by Nattaporn Jengwareewong
(Mr.Nattaporn Jengwareewong)
RYG Field Service Specialist (1)



Reference Dry Gas Meter Data

Reference Dry Gas Meter ID	:	BKK_FS1122
Serial No.	:	A2003240
Correction Factor (Y)	:	0.9824
Next Calibration Date	:	7-Nov-24

Calibration No.	:	C-100724-BKK_FSD468
Dry Gas Meter ID	:	BKK_FSD468
Serial No.	:	1302005
Model No.	:	XC-577-V

[illegible]

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

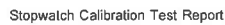
Δp_{Hg} : Clinico pressure differential that equals to 21.24 mm of air @ 25 °C and 760 mm of mercury, mmH₂O; tolerance for individual values \pm 5.08 from average.

Approved by:

...and the ...

(Mr.Nalhapol Jangwattwong)

FORM NO. 1 56-024 REVISION NO. 2 ISSUED DATE 30 JUN 22



Reference Stopwatch Data		Console Control	Meter Data
Stopwatch ID No.:	RYG_FS0540	Dry Gas Meter No.	BKK_FS0468
Model:	F808	Model:	XC-572-V
Serial No.:	E16051	Serial No.:	1302005
Calibration Date:	4 Jul 24		
Certificate No.:	E-2407022		

Calibrate by: Saksit Phaisanphisit
Mr. Saksit Phaisanphisit
RYG Field Service Scientist (4)

Approved by: Natthapol Jengwareewong
Mr. Natthapol Jengwareewong
RYG Field Service Specialist (1)



Calibration Date :	10 Jul 24	Ambient Temperature (°C)	33.8
Calibration sheet No. :	C-100724-BKK_FS0469	Relative Humidity (%) :	46.2
Digital Temperature ID :	BKK_FS04089	Reference Temperature ID	RYG_FS0801
Serial No. :	1302005	Serial No. :	201090014918
Model :	XC-572-V	Model :	Digitron-CC-VT-MS
		Next Calibrate :	13 Nov 24

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	150	0	±3	Pass
	200	201	1	±3	Pass
Probe	250	251	1	±3	Pass
	300	301	1	±3	Pass
	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่บ่งชี้

Calibrated by : Saksit Phaisanphit
(Mr. Saksit Phaisanphit)
RYG Field Service Scientist (4)

Approved by: Nattapol Jiengwareewong
(Mr.Nattapol Jiengwareewong)
RYG Field Service Specialist (1)

FORM NO. F 06-027 REVISION NO. 2 ISSUE DATE 16/2/23



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	10 Jul 24	Nozzle Set ID :	BKK_FS0474
Calibration Sheet No. :	C-100724-BKK_FS0474	Vernier Caliper ID :	BKK_FS1123

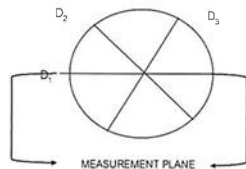
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	(D ₁ + D ₂ + D ₃) / 3
	D ₁	D ₂	D ₃	ΔD	D _{avg}
1	0.305	0.300	0.305	0.005	0.303
2	0.455	0.455	0.455	0.000	0.455
3	0.604	0.602	0.601	0.003	0.602
4	0.760	0.765	0.770	0.010	0.765
5	0.935	0.945	0.935	0.010	0.938
6	1.095	1.098	1.092	0.006	1.095
7	1.260	1.260	1.260	0.000	1.260
8	1.605	1.600	1.610	0.010	1.605

Where :

D₁, D₂, D₃ = There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.

D_{avg} = (D₁ + D₂ + D₃) / 3



Calibrated by : Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
RYG Field Services Scientist (4)

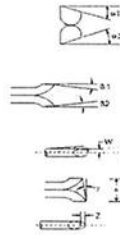
Approved by : Natthapol Jengwarewong
(Mr. Natthapol Jengwarewong)
RYG Field Services Specialist

FORM NO.: F-06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23



Type S Pitot Tube Calibration

Date Calibration 10-Jul-24 Due Date 10-Jan-25
Pitot ID BKK_FS0561 Inclinator ID BKK_FS1131
Pitot SN - Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
α1	-2.4	-10° < α1 < +10°	OK
α2	-1.2	-10° < α2 < +10°	OK
β1	-2.0	-5° < β1 < +5°	OK
β2	1.3	-5° < β2 < +5°	OK
γ	0.3	-	-
θ	0.2	-	-
Z = A tan γ	0.005	Z ≤ 0.125"	OK
W = A tan θ	0.003	W ≤ 0.031"	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.468	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.91	2.1Dt ≤ A ≤ 3Dt	OK

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by : Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
RYG Field Services Scientist (4)

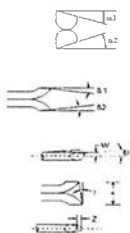
Approved by : Natthapol Jengwarewong
(Mr. Natthapol Jengwarewong)
RYG Field Services Specialist (1)

FORM NO.: F-06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23



Type S Pitot Tube Calibration

Date Calibration 10-Jul-24 Due Date 10-Jan-25
Pitot ID BKK_FS0473 Inclinator ID BKK_FS1131
Pitot SN - Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
α1	2.5	-10° < α1 < +10°	OK
α2	1.4	-10° < α2 < +10°	OK
β1	-0.8	-5° < β1 < +5°	OK
β2	-0.4	-5° < β2 < +5°	OK
γ	0.3	-	-
θ	0.2	-	-
Z = A tan γ	0.005	Z ≤ 0.125"	OK
W = A tan θ	0.003	W ≤ 0.031"	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.484	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.92	2.1Dt ≤ A ≤ 3Dt	OK

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by : Saksit Phaisanphisit
(Mr. Saksit Phaisanphisit)
RYG Field Services Scientist (4)

Approved by : Natthapol Jengwarewong
(Mr. Natthapol Jengwarewong)
RYG Field Services Specialist (1)

FORM NO.: F-06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykong, Huaykong, Bangkok 10310
Tel: +66 2643 8381-6, e-mail: service.thailand@sartorius.com



NSC-TS1-T15 17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY : Thawit
APPROVED BY : Ph
NEXT CAL DATE: 21/02/2025

Model Number : MSU224S-100-DU Certificate No. : 24BC10073
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 0031709552 Reference No. : 229198
ID No. : RYG_EN0003
Manufacturer : Sartorius Page No. : 1 of 2

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

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

Calibrated By : Mr.Chonchai Inthana Calibration
Calibration Date : Thursday, February 22, 2024 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
Temperature : 23.7 °C ± 5.0 °C
Humidity : 62.0 % RH ± 10.0 % RH
Pressure : - ± -
Reasons for calibration
☐ New Installation ☐ Service / Repair ☒ 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	TCS	M2306197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

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.

Chonchai Inthana

Mr.Chonchai Inthana(Technical Manager)



SOP FM 33 03 February 2022



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

CALIBRATION CERTIFICATE

Submitted by : A.I.S Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : Rion
Model : NL-42
Serial No. : 00900071 (ID: KYG_FS0492)
Microphone : UC-52 No.18464
Preamplifier : NH-24 No.01733
Standards used :

Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$



1. Band Pass Filter Wavetek 752A S/N 90010494,
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871,
3. Decade Attenuator Ando AL-205 S/N 00464602,
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668,
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037,
6. Digital Multimeter Fluke 8520A S/N 4985007,
7. Pistonphone Rion NC-72 S/N 00402446,
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484,

Date of Receipt : 24 Jan, 2024

Date of Calibration : 23 Feb.2024-1 Mar.2024

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FMBL/MTC.002 Rev.4

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650,
10. Speaker Tannoy Limited, Great Britain British Patent No. 213300,
11. Digital Multimeter Agilent 34401A S/N MY44005560,
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212,

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
	Before adjust	After adjust				
113.94	113.7	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.2 dB.

2. Self-generated noise

2.1 Normal test

Measured value: (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
17.3	0.10	N/A

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

Frequency- Weighting	Measured value (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
A-Weight	12.4	0.10	N/A
C-Weight	18.1	0.10	N/A
Flat	23.9	0.10	N/A

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
	A-weight	C-weight	Flat			
125	0.1	0.2	0.2	1.5	0.45	0.6
1 000	-0.1	-0.1	-0.1	1.0	0.45	0.6
8 000	0.3	0.3	0.2	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
	A-weight	C-weight	Flat			
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	0.0	2.0	0.20	0.6
4 000	0.0	0.0	0.0	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94,0	0,0	0,3	0,10	0,1
End	94,0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94,0	0,0	0,2	0,20	0,2
C-weight	94,0	0,0	0,2	0,20	0,2
Flat	94,0	0,0	0,2	0,20	0,2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94,0	0,0	0,1	0,20	0,2
Slow	94,0	0,0	0,1	0,20	0,2
Leq	94,0	0,0	0,1	0,20	0,2

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136,0	0,0	1,1	0,30	0,3
135	135,0	0,0	1,1	0,30	0,3
134	134,0	0,0	1,1	0,30	0,3
133	133,0	0,0	1,1	0,30	0,3
132	132,0	0,0	1,1	0,30	0,3
131	131,0	0,0	1,1	0,30	0,3
130	130,0	0,0	1,1	0,30	0,3
129	129,0	0,0	1,1	0,30	0,3
124	124,0	0,0	1,1	0,30	0,3
119	119,0	0,0	1,1	0,30	0,3
114	114,0	0,0	1,1	0,30	0,3
109	109,0	0,0	1,1	0,30	0,3
104	104,0	0,0	1,1	0,30	0,3
99	99,0	0,0	1,1	0,30	0,3
94	94,0	0,0	1,1	0,30	0,3
89	89,0	0,0	1,1	0,30	0,3
84	84,1	0,1	1,1	0,30	0,3
79	79,0	0,0	1,1	0,30	0,3
74	74,0	0,0	1,1	0,30	0,3
69	69,0	0,0	1,1	0,30	0,3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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FMBL/MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	64,0	0,0	1,1	0,30	0,3
59	59,0	0,0	1,1	0,30	0,3
54	53,9	-0,1	1,1	0,30	0,3
49	49,0	0,0	1,1	0,30	0,3
44	44,0	0,0	1,1	0,30	0,3
39	38,9	-0,1	1,1	0,30	0,3
34	33,9	-0,1	1,1	0,30	0,3
29	28,9	-0,1	1,1	0,30	0,3
28	27,9	-0,1	1,1	0,30	0,3
27	26,9	-0,1	1,1	0,30	0,3
26	25,9	-0,1	1,1	0,30	0,3
25	24,8	-0,2	1,1	0,30	0,3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94,0	94,0	0,0	1,1	0,30	0,3

Date of Calibration : 23 Feb.2024-1 Mar.2024

7/9

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 176/0167

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35,0	35,0	0,0	1,1	0,30	0,3

9. Tone burst response

Time Weighting	Toneburst Duration, Th (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126,0	0,0	±1,0	0,20	0,3
	2	108,9	+0,1	+1,0; -2,5	0,20	0,3
	0,25	99,9	+0,1	+1,5; -5,0	0,20	0,3
Slow	200	119,6	0,0	±1,0	0,20	0,3
	2	100,0	0,0	+1,0; -5,0	0,20	0,3
	0,25	90,0	0,0	+1,0; -5,0	0,20	0,3
SPL	2	100,0	0,0	+1,0; -2,5	0,20	0,3
	0,25	90,8	-0,2	+1,5; -5,0	0,20	0,3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
Complete cycle	125.4	125.2	-0.2	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
Positive one-half cycle	Negative one-half cycle				
135.0	135.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Approved by :

(Mr. Tawikiat Jamsanin)

(Mr. Prawat Klanya)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Feb.2024-1 Mar.2024

Date of Issue : 1 Mar, 2024

Ref: 2011267012400347006

End of Certificate

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- Power Amplifier Brüel&Kjær 2706 S/N 1517650,
- Speaker Tannoy Limited, Great Britain British Patent No. 215300,
- Digital Multimeter Agilent 34401A S/N MY4400560,
- Programmable Attenuator Tamaawa TPA-303A S/N 2212,

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 23 Feb.2024-1 Mar.2024

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CALIBRATION CERTIFICATE

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

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sui IC, Bangpoo Industrial Estate, Sukhumvit Rd., A-Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00709746 (ID:RYG_FS0491)

Microphone : UC-52 No.187332

Preamplifier : NH-24 No.01297

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

- Band Pass Filter Wavecok 752A S/N 90010494,
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871,
- Decade Attenuator Ando AL-205 S/N 00464602,
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668,
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037,
- Digital Multimeter Fluke 8520A S/N 4985007,
- Pistonphone Rion NC-72 S/N 00402446,
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484,

Date of Receipt : 24 Jan, 2024

Date of Calibration : 23 Feb.2024-1 Mar.2024

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
	Before adjust	After adjust				
113.93	113.8	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.2 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
18.6	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
A-Weight	14.0	0.10	N/A
C-Weight	18.9	0.10	N/A
Flat	24.0	0.10	N/A

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 175/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0,1	0,2	0,2	1,5	0,45	0,6
1 000	-0,1	-0,1	-0,1	1,0	0,45	0,6
8 000	1,3	1,3	1,4	5,0	0,45	0,7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0,2	-0,2	-0,1	2,0	0,20	0,6
125	-0,2	-0,1	-0,1	1,5	0,20	0,6
250	-0,1	-0,1	-0,1	1,5	0,20	0,6
500	-0,1	0,0	0,0	1,5	0,20	0,6
1 000	0,0	0,0	0,0	1,0	0,20	0,6
2 000	-0,1	0,0	-0,1	2,0	0,20	0,6
4 000	-0,1	0,0	-0,1	3,0	0,20	0,6
8 000	0,0	0,0	-0,1	5,0	0,20	0,7

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 175/0167

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94,0	0,0	0,3	0,10	0,1
End	94,0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94,0	0,0	0,2	0,20	0,2
C-weight	94,0	0,0	0,2	0,20	0,2
Flat	94,0	0,0	0,2	0,20	0,2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94,0	0,0	0,1	0,20	0,2
Slow	94,0	0,0	0,1	0,20	0,2
Leq	94,0	0,0	0,1	0,20	0,2

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 175/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136,0	0,0	1,1	0,30	0,3
135	135,0	0,0	1,1	0,30	0,3
134	134,0	0,0	1,1	0,30	0,3
133	133,0	0,0	1,1	0,30	0,3
132	132,0	0,0	1,1	0,30	0,3
131	131,0	0,0	1,1	0,30	0,3
130	130,0	0,0	1,1	0,30	0,3
129	129,0	0,0	1,1	0,30	0,3
124	124,0	0,0	1,1	0,30	0,3
119	119,0	0,0	1,1	0,30	0,3
114	114,0	0,0	1,1	0,30	0,3
109	109,0	0,0	1,1	0,30	0,3
104	104,0	0,0	1,1	0,30	0,3
99	99,0	0,0	1,1	0,30	0,3
94	94,0	0,0	1,1	0,30	0,3
89	89,0	0,0	1,1	0,30	0,3
84	84,0	0,0	1,1	0,30	0,3
79	78,9	-0,1	1,1	0,30	0,3
74	74,0	0,0	1,1	0,30	0,3
69	68,9	-0,1	1,1	0,30	0,3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 175/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	63,9	-0,1	1,1	0,30	0,3
59	58,9	-0,1	1,1	0,30	0,3
54	53,9	-0,1	1,1	0,30	0,3
49	48,9	-0,1	1,1	0,30	0,3
44	43,9	-0,1	1,1	0,30	0,3
39	38,9	-0,1	1,1	0,30	0,3
34	33,9	-0,1	1,1	0,30	0,3
29	29,0	0,0	1,1	0,30	0,3
28	28,0	0,0	1,1	0,30	0,3
27	27,0	0,0	1,1	0,30	0,3
26	26,1	0,1	1,1	0,30	0,3
25	25,1	0,1	1,1	0,30	0,3

8. Level linearity including the level range control

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94,0	94,0	0,0	1,1	0,30	0,3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35.0	35.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T _b (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.1	0.1	±1.0	0.20	0.3
	2	109.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
	0.25	90.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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FM.SL.MTC.002 Rev. 4

CALIBRATION CERTIFICATE

Submitted by : A.I.S. Laboratory Group (Thailand) Co., Ltd.

Address : 104 Phatthananak 40, Phatthananak Rd., Khwaeng Phatthananak, Khet Suan Luang, Bangkok 10250,

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280,

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00900072 (ID:RYG_FSD493)

Microphone : UC-52 No.188463

Preamplifier : NH-24 No.01734

Standards used :

1. Band Pass Filter Wavelek 752A S/N 90010494,
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871,
3. Decade Attenuator Ando AL-205 S/N 00464602,
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668,
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037,
6. Digital Multimeter Huke 8520A S/N 4985007,
7. Pistonphone Rion NC-72 S/N 00402446,
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484,

Date of Receipt : 24 Jan. 2024

Date of Calibration : 23 Feb.2024-1 Mar.2024

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FM.SL.MTC.002 Rev. 4

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.4	0.0	3.0	0.20	0.35
Positive half cycle	124.4	124.4	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.4	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle 135.5	Negative one-half cycle 135.5	0.0	1.5	0.20

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Approved by :

(Mr. Tawikiat Janasamran)

(Mr. Pravee Khayapa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Feb.2024-1 Mar.2024

Date of Issue : 1 Mar. 2024

Ref : 2011267012400347005

End of Certificate

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FM.SL.MTC.002 Rev. 4

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650,

10. Speaker Tannoy Limited, Great Britain British Patent No. 215300,

11. Digital Multimeter Agilent 34401A S/N MY44005560,

12. Programmable Attenuator Temagawa TPA-303A S/N 2212,

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.91	114.0	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed in the display of 123.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
17.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	11.3	0.10	N/A
C-Weight	17.0	0.10	N/A
Flat	23.4	0.10	N/A

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.3	0.4	0.4	1.5	0.45	0.6
1 000	-0.2	-0.2	-0.2	1.0	0.45	0.6
8 000	-0.4	-0.5	-0.5	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency	Deviation from frequency response (dB)			Acceptance limit class 2	Uncertainty	Maximum-permitted
(Hz)	A-weight	C-weight	Flat	(±dB)	(±dB)	uncertainty of measurement (±dB)
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	-0.1	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	0.0	2.0	0.20	0.6
4 000	-0.1	0.0	0.0	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.1	0.1	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35.0	35.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T _b (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	109.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	99.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3
SEL	200	120.0	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 23 Feb.2024-1 Mar.2024

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Request No. 21-67/0232

MTC No. EEL, BP, 177/0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.2	-0.2	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (-dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
135.5	135.5	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :
(Mrs. Thiwakiat Jamsunran)

Approved by :
(Mr. Prawate Klasyra)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Feb.2024-1 Mar.2024

Date of Issue : 1 Mar. 2024

Ref: 2011267012400347007

End of Certificate

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Cert. No. : ACL24306
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00597169 / 158770 / 34370
ID No. : RYG_FS0439

Condition As Found : GOOD

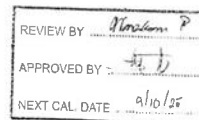
Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATHANAKAN 40, PHATHANAKAN ROAD,
KHWAENG PHATHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 23 SEPTEMBER 2024
Calibration Date : 09 OCTOBER 2024
Date of Issue : 09 OCTOBER 2024

Calibrated by :
Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchurai)



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Cert. No. : ACL24306
Job No. : VC67AC0164
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow 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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977960	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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),

7. Petch.

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Cert. No. : ACL24306
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Summary of Measurement Result :

Parameter	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

7. Petch.

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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.4

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

Frequency Weighting	Weighting (dB)
A-weight	10.8
C-weight	16.8
Flat	22.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	±1.5
1000	0.0	0.0	0.0	±1.0
8000	+1.9	+1.8	+1.8	±5.0

7. Petch.

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/15 Srinthorn Road, Banglumru, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACL24306
Job No. : VC67AC0164
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

7. Petch.

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CALIBRATION LABORATORY

451-451/7 Srinthorn Road, Bangbunmu, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

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associates



Cert. No. : ACL24306
Job No. : VC67AC0164
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.3	0.3	± 1.1

7. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/7 Srinthorn Road, Bangbunmu, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACL24306
Job No. : VC67AC0164
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	30.1	0.1	±1.1

9. Tone burst response

Time Weighing	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

7. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/7 Srinthorn Road, Bangbunmu, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACL24306
Job No. : VC67AC0164
Pages : 8 of 8

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	±3.0
One	136.4	136.3	-0.1	±3.0

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

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

7. Petch

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 29 January 2024

CERTIFICATE NUMBER 207437

REVIEW BY *Jonathan P*
APPROVED BY *h*
EFFECTIVE DATE 28/1/24

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2
Approved signatory
N.Smith
Electronically signed:
N.D. S...

doseBadge Reader : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc

Notes:

Model: RC:110A

Serial number: 73729

Class: 2

Test summary

Date of calibration: 29 January 2024

The doseBadge reader detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942_2003 Annex B - Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The doseBadge Reader has been shown to conform to the Class 2 requirements for periodic testing, described in Annex B of IEC 60942:2003 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

However, as public evidence was not available, from a testing organisation responsible for pattern approval, to demonstrate that the model of doseBadge Reader conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, no general statement or conclusion can be made about conformance of the doseBadge Reader to the requirements of IEC 60942:2003.

Notes:

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number:
207437
Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:
Before Pressure: 101,44 kPa Temperature: 21,3 °C Humidity: 35,8 %
After Pressure: 101,44 kPa Temperature: 21,3 °C Humidity: 35,9 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Distortion Meter	Keithley	2015	0994818
Acoustic Calibrator	Brüel and Kjær	4231	2610257
Environmental Monitor	Comet	T7510	21962628

Initial Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114,00	114,31	114,31	114,29	114,30	0,30	±0,75	0,11 dB
Distortion (%)	< 4,00	0,32	0,26	0,40	0,33	0,33	+4,00	0,13 %
Frequency (Hz)	1000,0	998,2	998,3	998,3	998,3	-1,7	±20,0	0,1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

Adjusted Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114,00	114,01	114,01	114,02	114,01	0,01	±0,75	0,11 dB
Distortion (%)	< 4,00	0,30	0,34	0,34	0,33	0,33	+4,00	0,13 %
Frequency (Hz)	1000,0	998,1	998,3	998,3	998,2	-1,8	±20,0	0,1 Hz

Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
2 way IR link	Pass
Clock	Pass

End of results

CERTIFICATE OF CALIBRATION

ISSUED BY
DATE OF ISSUE
29 January 2024

Cirrus Research plc
29 January 2024

CERTIFICATE NUMBER
207436

Page 1 of 2

Approved signatory
N.Smith
Electronically signed:

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

doseBadge Reader : IEC 60942:2003

Instrument information
Manufacturer: Cirrus Research plc
Model: RC:110A
Serial number: B9107
Class: 2

Notes:
The doseBadge reader detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942_2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.
The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.
The results have been corrected to the reference pressure of 101,33 kPa using the manufacturer's data.
The doseBadge Reader has been shown to conform to the Class 2 requirements for periodic testing, described in Annex B of IEC 60942:2003 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.
However, as public evidence was not available, from a testing organisation responsible for pattern approval, to demonstrate that the model of doseBadge Reader conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, no general statement or conclusion can be made about conformance of the doseBadge Reader to the requirements of IEC 60942:2003.

Notes:

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number:
207436
Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:
Before Pressure: 101,41 kPa Temperature: 21,2 °C Humidity: 37,1 %
After Pressure: 101,41 kPa Temperature: 21,2 °C Humidity: 37,4 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Distortion Meter	Keithley	2015	0994818
Acoustic Calibrator	Brüel and Kjær	4231	2610257
Environmental Monitor	Comet	T7510	21962628

Initial Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114,00	113,55	113,54	113,54	113,54	-0,46	±0,75	0,11 dB
Distortion (%)	< 4,00	0,43	0,45	0,42	0,44	0,44	+4,00	0,13 %
Frequency (Hz)	1000,0	1002,3	1002,3	1002,3	1002,3	2,3	±20,0	0,1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

Adjusted Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114,00	113,98	114,01	114,01	114,00	0,00	±0,75	0,11 dB
Distortion (%)	< 4,00	0,33	0,34	0,33	0,33	0,33	+4,00	0,13 %
Frequency (Hz)	1000,0	1002,3	1002,3	1002,3	1002,3	2,3	±20,0	0,1 Hz

Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
2 way IR link	Pass
Clock	Pass

End of results

J NAC
JIRANAT ASSOCIATES CO. LTD.

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

Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-144-67

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Heat Stress Monitor
Delta DHM
HD932
22016390
RYG_F50S80
Used item
ALS laboratory group (thailand) Co., Ltd.
104 Phatthanasirak 46, Phatthanasirak Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 19 Jul 2024
MEASUREMENT DATE : 07 Aug 2024
ISSUE DATE : 07 Aug 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

NOTED: The certificate is valid only to the item calibrated on date and place of calibration

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

Traceability:
The measurement results are traceable to the
international system of units (SI) through
National Institute of Metrology (NIMT),
Certificate number: 17-0547-24, Certificate
number: Ea-0101-23.

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100-A500, Serial No. 467662-08,
Due date: 16-Mar-2025
2. Digital Temperature Indicator
Model: DTH-1000-A-MK II, Serial No.: 671407,
G0097, Due date: 14-Sep-2024

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

Calibrated by:
[1] Mr. Sorawit Thachalad
[2] Mrs. J. Uraiporn Lertsomphol
[3] Mrs. Puangrump Poommit

Approved signatory
Mr. Pannya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 22025580,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.059	20.0	-0.1	0.099
90	25.054	25.0	-0.1	0.099
80	30.045	30.0	-0.1	0.099
80	35.036	35.0	-0.1	0.099
80	40.027	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.25/N: 22023942,
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.050	20.1	0.0	0.099
110	25.054	25.1	0.0	0.099
110	30.045	30.1	0.1	0.099
110	35.037	35.0	0.0	0.099
110	40.027	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 22025040,
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.059	20.1	0.0	0.099
75	25.054	25.0	-0.1	0.099
75	30.045	29.9	-0.1	0.099
75	35.037	34.9	-0.1	0.099
75	40.027	39.9	-0.2	0.099

UUC: Under Calibration

End of Certificate of Calibration



Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021466,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.053	20.0	-0.1	0.099
80	25.045	25.0	0.0	0.099
80	30.040	30.0	0.0	0.099
80	35.039	35.0	0.0	0.099
80	40.030	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276.2 S/N: 18020493,
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.052	20.0	0.0	0.14
110	25.045	25.0	0.1	0.099
110	30.040	30.1	0.1	0.099
110	35.039	35.1	0.1	0.099
110	40.030	40.1	0.1	0.099

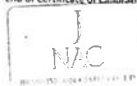
Table 3: This equipment was connected with temperature probe Model: TP9207.2 S/N: 18021258,
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.053	20.2	0.1	0.099
75	25.045	25.0	0.0	0.099
75	30.040	30.0	0.0	0.099
75	35.039	34.9	-0.1	0.099
75	40.030	39.9	-0.1	0.099

UUC*: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.14, based on standard uncertainty multiplied by a coverage factor k=2,14 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-010-67

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006711
ID NUMBER : RYG_FS0217
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 05 Jan 2024
MEASUREMENT DATE : 08 Jan 2024
ISSUE DATE : 09 Jan 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The temperature calibration was done by In-House calibration method at WH-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: IT-0038-23, Certificate number: ER-0101-23

Reference Used During Calibration:

1. Standard Temperature Probe Model: STS-100 AS50, Serial No. 667682-05, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No. 671407-00591 Due date: 14 Sep 2024

Uncertainty of Measurement:

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



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008206,
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.059	20.2	0.1	0.099
80	25.051	25.2	0.1	0.099
80	30.047	30.2	0.2	0.099
80	35.039	35.2	0.2	0.099
80	40.035	40.2	0.2	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276.2 S/N: 17015123,
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.059	20.2	0.1	0.099
110	25.052	25.2	0.1	0.099
110	30.047	30.2	0.2	0.099
110	35.039	35.2	0.2	0.099
110	40.035	40.2	0.2	0.099

Table 3: This equipment was connected with temperature probe Model: TP9207.2 S/N: 17003950,
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.059	20.2	0.1	0.099
75	25.052	25.1	0.0	0.099
75	30.047	29.9	-0.1	0.099
75	35.040	34.8	-0.2	0.099
75	40.036	39.7	-0.3	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-143-67

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 22016385
ID NUMBER : RYG_FS0579
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 15 Jul 2024
MEASUREMENT DATE : 05 Aug 2024
ISSUE DATE : 07 Aug 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The temperature calibration was done by In-House calibration method at WH-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

Traceability:

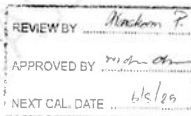
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: IT-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:

1. Standard Temperature Probe Model: STS-100 AS50, Serial No. 667682-05, Due date: 28 Mar 2025
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No. 671407-00591 Due date: 14 Sep 2024

Uncertainty of Measurement:

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



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18009587.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	20.1	0.1	0.099
80	25.042	25.1	0.1	0.099
80	30.040	30.0	0.0	0.099
80	35.035	35.0	0.0	0.099
80	40.026	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP9276.2 S/N: 15015967.
Dimension: Diameter 3.3 mm, Length 205 mm.

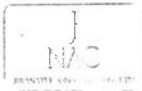
Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.049	20.0	0.0	0.099
110	25.042	25.0	0.0	0.099
110	30.040	30.0	0.0	0.099
110	35.034	35.0	0.0	0.099
110	40.026	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015492.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.049	20.2	0.2	0.099
75	25.042	25.1	0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.034	34.8	-0.1	0.099
75	40.026	39.9	-0.1	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CDT-055-67

Page 1 of 2 Pages

MEASUREMENT ITEM: Heat Stress Monitor
MANUFACTURER: Delta OHM
MODEL/TYPE: HD32.2
SERIAL NUMBER: 15006714
ID NUMBER: RYG_FS0219
CONDITION AS-RECEIVED: Used Item
CUSTOMER: ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE: 12 Feb 2024
MEASUREMENT DATE: 15 Feb 2024
ISSUE DATE: 20 Feb 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

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

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).
Certificate number: TT-0036-23, Certificate number: TR-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

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



Approved signatory
Mr. Panyia Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 22035263.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.063	20.4	0.3	0.099
80	25.054	25.4	0.3	0.099
80	30.040	30.4	0.4	0.099
80	35.026	35.4	0.4	0.099
80	40.018	40.4	0.4	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17023217.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.3	0.2	0.099
110	25.054	25.3	0.2	0.099
110	30.040	30.3	0.3	0.099
110	35.027	35.3	0.3	0.099
110	40.018	40.3	0.3	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015491.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.064	20.5	0.4	0.099
75	25.054	25.4	0.3	0.099
75	30.041	30.4	0.4	0.099
75	35.026	35.3	0.3	0.099
75	40.018	40.2	0.2	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CDT-017-67

Page 1 of 2 Pages

MEASUREMENT ITEM: Heat Stress Monitor
MANUFACTURER: Delta OHM
MODEL/TYPE: HD32.2
SERIAL NUMBER: 15006718
ID NUMBER: RYG_FS0223
CONDITION AS-RECEIVED: Used Item
CUSTOMER: ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE: 11 Jan 2024
MEASUREMENT DATE: 12 Jan 2024
ISSUE DATE: 17 Jan 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

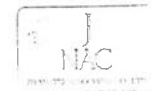
The table on next page give the measured values.

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

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).
Certificate number: TT-0036-23, Certificate number: TR-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

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



Approved signatory
Mr. Panyia Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18009588.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.053	20.1	0.0	0.099
80	25.045	25.1	0.1	0.099
80	30.040	30.1	0.1	0.099
80	35.039	35.1	0.1	0.099
80	40.030	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20019638.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.053	20.1	0.1	0.14
110	25.045	25.1	0.1	0.099
110	30.040	30.3	0.3	0.099
110	35.039	35.3	0.3	0.099
110	40.030	40.3	0.3	0.099

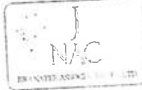
Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015496.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.053	20.2	0.1	0.099
75	25.045	25.1	0.1	0.099
75	30.040	30.0	0.0	0.099
75	35.039	34.9	-0.1	0.099
75	40.030	39.8	-0.2	0.099

UUC*: Unc Under Calibration

Remark: The reported uncertainty of measurement is 0.14, based on standard uncertainty multiplied by a coverage factor k=2.14 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-75 37025
CALIBRATION 0367

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-75 37025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-015-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor
MANUFACTURER : Delta OHM
MODEL/TYPE : HD32.2
SERIAL NUMBER : 15006715
ID NUMBER : RYG_FS0220
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE : 11 Jan 2024
MEASUREMENT DATE : 11 Jan 2024
ISSUE DATE : 17 Jan 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

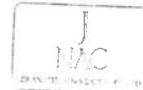
Calibration procedure:
The temperature calibration was done by
In-House calibration method as HP-CL-001
according to comparison method with standard
digital temperature indicator and standard
temperature probe. The temperature scale use
was based on ITS-90.

Traceability:
The measurement results are traceable to the
international system of units (SI) through
National Institute of Metrology Thailand (NIMT)
Certificate number: TT-0036-25, Certificate
number: ER-0101-23

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100-A500, Serial No.: 667682-08,
Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI 1000-A MK II, Serial No.: 071407-
00591 Due date: 14 Sep 2024

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

Calibrated by:
☒ Mr. Sornwit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpa Phoommit



Approved signatory

Mr. Panniya Booncharoen
Calibration Department Manager

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

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 17022563.
Dimension: Diameter 3.3 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.050	20.0	0.0	0.099
80	25.042	25.0	0.0	0.099
80	30.040	30.0	0.0	0.099
80	35.034	35.0	0.0	0.099
80	40.026	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3275.2 S/N: 20019632.
Dimension: Diameter 3.3 mm, Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.050	20.0	0.0	0.099
110	25.042	25.0	0.0	0.099
110	30.040	30.1	0.1	0.099
110	35.034	35.1	0.1	0.099
110	40.026	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015507.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.050	20.2	0.2	0.099
75	25.042	25.0	0.0	0.099
75	30.040	30.0	0.0	0.099
75	35.034	35.0	0.0	0.099
75	40.026	39.9	-0.1	0.099

UUC*: Unc Under Calibration

End of Certificate of Calibration



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
2344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK, 10259
TEL: 0-2717-3000-31 FAX: 0-2719-9184



Certificate of Calibration

Certificate No. : 24PH145
Page : 1 of 2

Equipment : Lux Meter
Manufacturer : Tenmars
Model : TM-201L
Serial No. : 190702490
ID No. : RYG_FS0471
Condition As-Received: Used Item
Received Date : 12 March 2024
Calibration Date : 14 March 2024
Reference : 2403-0392WSC
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %

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.

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

Procedure used: Calibration were conducted using calibration procedure No. CP-PH01 based on inverse square law technique.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9.6 m	120RC003	DL-0064-22	20 Jul 2025
2) Luminous intensity standard lamp	QL FEL-U	F-1543	TP-1030-23	08 Jun 2024

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

3. Test Equipment : Programmable Voltage/Current Source (Model : OL83A, SN : 16221354)

4. Test Equipment : Illuminance Meter (Model : 51002, SN : 080129)

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

6. This Certification is traceable to the International System of Unit maintained through:-

- National Institute of Metrology Thailand (NIMT)

- National Institute of Metrology (Thailand), NSC-ONSC Accredited No. Calibration 0144

Calibrated by : Nivar Niaz
Issue Date : 18 March 2024

Approved Signatory :

☐ Phalinee Praipaisai
☐ Wanlop Larpkum
☐ Nuntawee Khanchai



Cert. No.: 24PH145
Page: 2 of 2

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

Function : Illuminance Measurement	Standard Value	UUC* Reading	Error	Uncertainty
	(lx)	(lx)	(lx)	(± lx)
	0	0.0	0.0	*
	20	20.1	0.1	0.28
	50	50.0	0.0	0.65
	100	100.0	0.0	1.3
	150	150.0	0.0	2.0
	190	190.0	0.0	2.5

Function : Illuminance Measurement	Standard Value	UUC* Reading	Error	Uncertainty
	(lx)	(lx)	(lx)	(± lx)
	200	199	-1	2.6
	500	499	-1	6.5
	1000	1000	0	13
	1500	1501	1	20
	1900	1901	1	25

Function : Illuminance Measurement	Standard Value	UUC* Reading	Error	Uncertainty
	(lx)	(lx)	(lx)	(± lx)
	2000	1990	-10	26
	3000	3000	0	39
	4000	4000	0	52
	5000	5000	0	65

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

UUC* = Unit Under Calibration.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/14 BATTANAKARN ROAD 501 18, SUANLUANG, SUANLUANG, BANGKOK 10240
TEL: 0-2713-3095-24 FAX: 0-2713-9484



Certificate of Calibration

Certificate No.: 24PH471
Page: 1 of 2

Equipment : Lux Meter
Manufacturer : PEAK METER
Model : PM6612L
Serial No.: H124-D16371
ID No.: RYG_FS0538
Condition As-Received: Used Item
Received Date: 04 September 2024
Calibration Date: 10 September 2024
References: 2405-0132WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.,
104 Phoththanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Procedure used: Calibration were conducted using calibration procedure No. CP-PH01 based on Inverse square law technique.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9.8 m	120RC003	DL-0064-22	20 Jul 2025
2) High-accuracy Irradiance Standard	OL-FEL-U	F-1471	TP-1048-23	01 Oct 2024
2. This result of calibration was made on requested at the point specified by customer.				
3. Test Equipment : Programmable Voltage/Current Source (Model : OL83A, SN : 09220284).				
4. Test Equipment : Illuminance Meter (Model : 51002, SN : 080129).				
5. The certificate is valid only to the item calibrated on date and place of calibration.				
6. This Certification is traceable to the International System of Unit maintained through:- - National Institute of Metrology Thailand (NIMT)				

REVIEW BY	<i>Phalinee Prapatsap</i>
APPROVED BY	<i>Chatchawan Khunpluek</i>
NEXT CAL. DATE	10/01/25

Calibrated by : Nival Nilas
Issue Date : 11 September 2024

Approved Signatory :
[] Phalinee Prapatsap
[] Chatchawan Khunpluek
[✓] Nival Nilas



Cert. No.: 24PH471
Page: 2 of 2

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

Function : Illuminance Measurement	Standard Value	Before Adjust UUC* Reading	After Adjust UUC* Reading	Error	Uncertainty
	(lx)	(lx)	(lx)	(lx)	(± lx)
	0	0.00	0.00	0.00	*
	15	*	15.18	0.18	0.22
	100	*	100.6	0.6	1.5
	500	*	499	-1	7.1
	1000	923	1000	0	15
	2000	*	2028	28	29
	3000	*	3030	30	44
	4000	*	4060	60	58
	5000	4710	5090	90	73

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

Before adjustment light source factor setting mode : L0 = 1.264

After adjustment light source factor setting mode : L0 = 1.359

UUC* = Unit Under Calibration.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/14 BATTANAKARN ROAD 501 18, SUANLUANG, SUANLUANG, BANGKOK 10240
TEL: 0-2713-3095-24 FAX: 0-2713-9484



Certificate of Calibration

Cert. No.: 24CH95
Page: 1 of 3

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact S220
Serial No.: C104059460
ID No.: RYG_EN0183
Condition As-Received: Used Item
Received Date: 16 January 2024
Calibration Date: 19 January 2024
Reference: 2401-0578DSC-2
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method
- CP-CHS by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CHB by comparison with temperature standard

REVIEW BY	<i>N. Banth</i>
APPROVED BY	<i>P. Banth</i>
NEXT CAL. DATE	19/01/25

Calibrated by : Warakorn Lemgagrakul

Approved by :
Saithip Meangmai
Approved Signatory

(✓) Saithip Meangmai
() Warakorn Lemgagrakul
() Ponpan Paipim

Issue Date : 24 January 2024

The Uncertainty is for a confidence probability of approximately 95%

A 0062854



Cert.No.: 24CH96
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

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

- Technology Promotion Association (Thailand-Japan)

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	940102	27 Nov 2025
pH 6.996	CPA chem	940104	02 Nov 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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	mV	pH		
pH Meter S/N : C104059460	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	



Cert.No.: 24CH96
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.01,7.00,10.01)

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 : 3225367	4.008	4.013	176.0	0.0054	2.07
	6.996	6.983	2.2	0.0084	2.00
	9.997	9.996	-174.1	0.0065	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLab®Expert Pro-ISM

- Serial No : 3225367

Dimension of probe

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.001	25.2	0.199	0.13	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 85 %.

-o0o-

Saitip

a 1198287

Saitip

a 1198288



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/14 PIG TANA-AIN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK, 10250
TEL. 0-2915-3660-244 FAX 0-2915-9918



Certificate of Calibration

Certificate No.: 24E289
Page: 1 of 2

Equipment :	pH Meter	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
Manufacturer :	Mettler Toledo	
Model :	SevenCompact S220	
Serial No. :	C104059460	
ID No. :	RYG_EN0163	
Condition As-Received :	Used item	
Received Date :	16 January 2024	
Calibration Date :	23 January 2024	
Reference :	2401-0578DSC	Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd (Rayong Branch)
Ambient Temperature :	(23 \pm 2) °C	616/10 Moo 5, T.Mae-am Khui, A.Pluakdaeng
Relative Humidity :	(50 \pm 10) %	Rayong 21140, Thailand

Procedure used: Calibration were conducted using calibration procedure No. CP-E17 According to EURAMET cg-15

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi Product Calibrator	5506A	6315011	E2U200035	29 May 2024

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

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

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

-NA Calibration Co.,Ltd. ANAB Accredited No. Calibration AC-2658

Calibrated by : Wutcharaporn Wongchulakane Approved Signatory :
Issue Date : 24 January 2024

[] Phalinee Prabprapai
[x] Nuntawat Khanchai
[] Pongsagorn Boonyaporn

B 0333296



Cert. No.: 24E289
Page.: 2 of 2

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

Function: DC voltage measurement

Range: 2000 mV

Standard Value	UUC* Reading	Error	Uncertainty
(mV)	(mV)	(mV)	(\pm μ V)
-200.0000	-200.0	0.0	68
-150.0000	-150.0	0.0	65
-100.0000	-100.0	0.0	63
-50.0000	-50.0	0.0	61
0.0000	0.0	0.0	58
50.0000	50.0	0.0	61
100.0000	99.9	-0.1	63
150.0000	149.9	-0.1	65
200.0000	199.9	-0.1	68

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

UUC* = Unit Under Calibration.

-o0o-

a 1198963



Certificate of Calibration

REVIEW BY: *Prasit*
APPROVED BY: *D. J.*
NEXT CAL. DATE: 02/02/2025

Model Number: MSE224S-100-DU Certificate No.: 24BC10059
Description: Analytical Balance Issued Date: Friday, February 23, 2024
Serial Number: 0026207038 Reference No.: 229196
ID No.: RYG_EN0002
Manufacturer: Sartorius Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
618/10 Moo 5 T. Maenam Khu. A. Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
618/10 Moo 5 T. Maenam Khu. A. Pluak Daeng, Rayong 21140, Thailand.

Calibrated By: Mr. Chonchai Inthana
Calibration Date: Thursday, February 22, 2024

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

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Ambient Conditions:
Temperature: 24.2 °C ± 5.0 °C
Humidity: 57.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration
☐ New Installation ☐ Service / Repair ☒ 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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

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

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 24BC10059
Description: Analytical Balance Issued Date: Friday, February 23, 2024
Serial Number: 0026207038 Reference No.: 229196
ID No.: RYG_EN0002
Manufacturer: Sartorius Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load with a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability 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 R110).	
Nominal Value : (Low Load)	20.0000 199.9999	Nominal value :	100 g
20 g	20.0000 200.0000	Tolerance	0.0004 g
Tolerance	0.0001 g		
Nominal Value : (High Load)	19.9999 200.0000		
200 g	20.0000 200.0000		
Tolerance	0.0001 g		
Standard Deviation	0.00007 0.00006		

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	0.00018
0.05	0.0500	0.0500	0.0000	0.00018
0.1	0.1000	0.1000	0.0000	0.00018
0.5	0.5000	0.5000	0.0000	0.00018
1	1.0000	1.0000	0.0000	0.00018
5	5.0000	5.0000	0.0000	0.00018
10	10.0000	10.0000	0.0000	0.00018
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	49.9999	-0.0001	0.00019
100	100.0000	100.0000	0.0000	0.00023
200	200.0000	199.9999	-0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022



Certificate of Calibration

Cert. No.: 24TM632
Page : 1 of 3

Equipment: Hot Air Oven
Manufacturer: Menmert
Model: UFE 500
Serial No.: G511.1572
ID No.: RYG_EN0010

REVIEW BY: *Thanitak*
APPROVED BY: *D. J.*
NEXT CAL DATE: 21/09/25

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

Location: Oven Room

Received Order: 21 March 2024
Calibration Date: 21 March 2024
Ambient Temperature: (26 ± 10) °C
Relative Humidity: (50 ± 30) %

Calibrated by: Man Pattanapongpalboon

Approved by: *S. J.*
Approved Signatory

() Pornthipha Tameyakul
() Unnophol Harachal
(✓) Suwit Imjai

Issue Date: 22 March 2024

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.



Equipment: Hot Air Oven
Condition As-Received: Used Item
Reference: 2403-0563OC-1
Procedure Used:-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

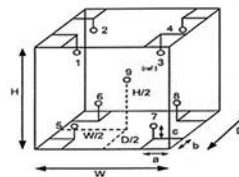
Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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.

Remark: TPA: Technology Promotion Association (Thailand - Japan)

Result of Calibration :-

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



Probe Installation Details: Dimension of Chamber :
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.56 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL Humid. (%)	57	59
AC Supply (Volt)	222	224

Ref. Std. ID No.: @ Calibration Point		
Position:	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-1
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM632
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.051	0.59	0.62	2
180.0	180.0	180.0	0.15	1.3	1.7	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	103.921	103.786	103.757	103.759	103.950	103.617	104.213	103.672	103.673	0.42
180.0	179.614	179.270	179.145	179.599	180.001	180.423	180.293	180.629	179.429	1.1

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-8484



Certificate of Calibration

Cert. No.: 24TM634
Page : 1 of 3

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 110
Serial No. : B423.0853
ID No. : RYG_EN0213
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140 Thailand
Location : Oven Room
Received Order : 21 March 2024
Calibration Date : 21 - 22 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpalboon
Approved by :
Approved Signatory
() Pornthippha Tameyakul
() Unnopphol Harachai
(x) Suwit Imjai

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3

Cert. No.: 24TM634
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument Serial No. Cert. No. Traceable Due Date
1) Data Acquisition MY57013711 23LM115 TPA 11 Jul 2024

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

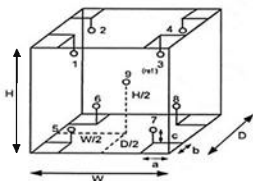
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration : (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.56 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	59	59
AC Supply (Volt)	224	223

Ref. Std. ID No.: @ Calibration Point		
Position :	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM634
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.065	0.52	0.60	2
180.0	180.0	180.0	0.20	1.2	2.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.506	103.898	103.712	103.772	103.730	104.289	103.805	103.798	0.42
180.0	180.701	179.239	179.935	179.999	180.127	180.138	180.895	179.313	180.211	1.1

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

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

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Certificate of Calibration

Cert. No.: 24TM635
Page : 1 of 3

Equipment : Water Bath
Manufacturer : Memmert
Model : WNB22
Serial No. : L513.0648
ID No. : RYG_EN0061
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140, Thailand
Location : Wet Chemistry Lab
Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanasongpalboon
Approved by :
() Pornthipha Tameyakul
() Unnophol Harachai
(✓) Suwit Imjai
Issue Date : 23 March 2024

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.



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Procedure Used :-

Cert. No.: 24TM635
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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.

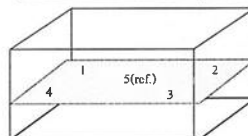
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :-

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	
Beginning of Calibration	25	55	222
Finished of Calibration	25	57	223



Front

Position :	Ref. Std. ID No.:
1	4803988-001
2	4803988-002
3	4803988-003
4	4803988-004
5(ref.)	4803988-005



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 24TM635
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
85.0	85.0	85.0	84.428	84.424	84.489	84.507	84.477	0.18

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.19	0.11	2

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

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

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

UUC* : Unit Under Calibration

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

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

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Certificate of Calibration

Cert.No.: 24CH771
Page: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : B712669291
ID No. : RYG_FS0296
Condition As-Received : Used Item
Received Date : 28 June 2024
Calibration Date : 01 July 2024
Reference : 2406-0969DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage standard and direct measurement with certified reference material (CRM)
Calibrated by : Warakorn Lemgagrakul
Approved by :
() Unnophol Harachai
() Ponpan Palpim
(✓) Sathip Meangmai
Issue Date : 03 July 2024

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 24CH771
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	23E2802	27 Aug 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

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	970851	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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 Document Process Calibrator 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.: B712869291	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	-178	10.00	0.58	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (\pm)	Coverage factor k
pH Electrode S/N.: 2295995	4.008	4.01	166	0.0079	2.00
	6.986	6.99	-8	0.011	2.00
	9.997	10.00	-182	0.0095	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert. No.: 24LM106
Page.: 1 of 2

Equipment :	pH Meter with Sensor
Manufacturer :	Mettler Toledo
Model :	Seven2Go S2
Serial No. :	B712869291
ID No. :	RYG_FS0296
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location :	TPA On Site Calibration Laboratory
Received Order :	28 June 2024
Calibrated Date :	01 July 2024
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V

Calibrated by : Warakorn Lemgagitrakul

Approved by :

() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 03 July 2024

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.



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2406-0969DSC-2

Cert. No.: 24LM106
Page.: 2 of 2

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	231216	TPA	11 Oct 2024

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.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- () Without Adjustment

Function : Temperature measurement

This instrument was connected with temperature sensor, S/N.: 2295995

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (\pm °C)	Coverage Factor k
25.0	100	25.004	25.2	0.196	0.16	2.00
30.0	100	30.002	30.3	0.298	0.16	2.00
40.0	100	40.003	40.3	0.297	0.16	2.00
50.0	100	50.004	50.3	0.296	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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