

ภาคผนวก จ

ใบรับรองการสอบเทียบเครื่องมือ



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Propene (Propylene)	GC-MSD	RYG_EN0136	5-Jan-24	4-Jul-25	18
Ambient	Benzene	GC-MSD	RYG_EN0136	5-Jan-24	4-Jul-25	18
Ambient	Propylene Oxide	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Ambient	Propylene Oxide	Field Rotameter	RYG_FS0199	2-Jul-24	2-Oct-24	3
Ambient	Propylene Oxide	Field Rotameter	BKK_FS0573	2-Oct-24	2-Jan-25	3
Ambient	Propylene Oxide	GC-FID	BKK_EN0126	21-Apr-23	21-Oct-24	18
Ambient	Propylene Oxide	GC-FID	BKK_EN0126	22-Oct-24	22-Apr-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0085	19-Jun-23	19-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0649	20-Jun-23	20-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0081	18-Jan-23	18-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	18-Aug-23	18-Feb-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0608	18-Jul-24	18-Jan-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0159	21-May-24	21-Nov-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0141	20-Aug-24	20-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	18-Aug-23	18-Feb-25	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0494	23-Feb-24	22-Feb-25	12
Sea Water	pH at 25 °C	pH Meter	RYG_EN0152	14-Dec-23	11-Jun-25	18
Sea Water	Total Suspended Solids	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Sea Water	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Sea Water	Salinity	Conductivity meter	RYG_EN0029	4-Sep-23	4-Mar-25	18
Sea Water	Oil & Grease	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Sea Water	Oil & Grease	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Sea Water	Oil & Grease	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Sea Water	Temperature	pH meter	RYG_FS0606	30-Aug-24	30-Aug-25	12
Sea Water	Total Coliform	Autoclave	BKK_ML0041	4-Oct-23	4-Apr-25	18
Sea Water	Total Coliform	Incubator	BKK_ML0010	17-Jul-23	17-Jan-25	18
Sea Water	Total Coliform	Hot Air Oven	BKK_ML0013	23-Apr-24	23-Oct-25	18
Sea Water	Fecal Coliform	Autoclave	BKK_ML0041	4-Oct-23	4-Apr-25	18
Sea Water	Fecal Coliform	Incubator	BKK_ML0010	17-Jul-23	17-Jan-25	18
Sea Water	Fecal Coliform	Hot Air Oven	BKK_ML0013	23-Apr-24	23-Oct-25	18
Sea Water	Fecal Coliform	Water Bath	BKK_ML0056	1-Mar-24	1-Mar-25	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	14-Dec-23	11-Jun-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Petroleum Hydrocarbon	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Petroleum Hydrocarbon	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Total Petroleum Hydrocarbon	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	Temperature	pH meter	RYG_FS0596	1-Jul-24	1-Jul-25	12
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0003	2-Aug-24	2-Aug-25	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	4-Jul-23	4-Jan-25	18
Water Lab	Total Coliform	Autoclave	BKK_ML0041	4-Oct-23	4-Apr-25	18
Water Lab	Total Coliform	Incubator	BKK_ML0010	17-Jul-23	17-Jan-25	18
Water Lab	Total Coliform	Hot Air Oven	BKK_ML0013	23-Apr-24	23-Oct-25	18

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: RYG_EN0138
Organization Name: ALS Laboratory Group (Thailand) Co.Ltd.
Organization Location: 616/10, Moo 5, Tambol Mae Nam Khu, Phrak Daeng, Rayong, 21140, Thailand

Date: January 5, 2024 10:53:24 AM
EQP Name: Agilent/Recommended, Agilent/Recommended
EQP Revision: GC.02.54, GCMS.02.54
Overall Qualification Status: Pass

REVIEW BY *Chontichak*
APPROVED BY *Duke*
NEXT CAL. DATE *10/9/2025*

CDS Logon Verification - GC

Logon: chonticha.khunkaew

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety end Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Setpoint Status: Pass
Inlet Pressure: 25.0 psi
Accuracy: 0.0 psi
Agilent Recommended: 1.2 psi

Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0138

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Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890
Setpoint Status: Pass
Zone: Oven
Setpoint(Actual): 230.0 228 °C
Accuracy: -1.0 °C
Agilent Recommended: ≥ -1.0 °C % setpoint in K (-5.0 °C)
≤ 1.0 °C % setpoint in K (5.0 °C)

Setpoint Status: Pass
Zone: Oven
Setpoint(Actual): 100.0 100.6 °C
Accuracy: 0.6 °C
Agilent Recommended: ≥ -1.0 °C % setpoint in K (-3.7 °C)
≤ 1.0 °C % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Setpoint(Average): 100.0 100.8167 °C
Stability: 0.1 °C
Agilent Recommended: ≤ 0.5 °C

Overall GC Oven Temperature Stability Test Status

Pass

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Log Amp

Tested Combination1: Front SSL / External SQ
Name: 5977B
Setpoint Status: Pass

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1: Front SSL / External SQ
Name: 5977B
Setpoint Status: Pass
Amu: 1050 m/z
Drift After Five Minutes: 6 mV
RFPA Voltage: 509 mV
Agilent Recommended: ≥ -100 mV and ≤ 100 mV ≤ 1100 mV

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1: Front SSL / External SQ
Name: 5977B
Setpoint Status: Pass
Filament: 1
Setpoint Status: Pass
Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

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Tested Combination1: Front SSL / External SQ
Name: Manual Injection
Source: EI - Extractor

Setpoint Status: Completed
Injection Volume on Column: 1.0 uL

Overall Scouting Run Status
Completed

Signal to Noise EI

Tested Combination1: Front SSL / External SQ
Name: 5977B
Source: EI - Extractor
Filament: 1
Setpoint Status: Pass
Signal to Noise: 5113
Agilent Recommended: ≥ 1200

Source: EI - Extractor
Filament: 2
Setpoint Status: Pass
Signal to Noise: 4456
Agilent Recommended: ≥ 1200

Overall Signal to Noise EI Test Status

Pass

NOTE: This test's 2 comment(s) and 3 deviation(s) are available in the Attachments section.

Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0138

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Instrument Details

Purpose
This section describes the as found system configuration.

Details

System	
System ID	RYG_EN0136
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging
Teefed Combination1	
Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN16463238
Firmware Revision	B.02.04.3
Component ID/Asset No.	081117000236
Oven Type	Standard

Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External
Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	SQ
Name	5877B
Model Number	G7077B
Serial Number	US1701M008
Firmware Revision	5977 6.00.34
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
Component ID/Asset No.	081117000236
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of Elements	2

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System ID: RYG_EN0136

Electronic Signature

Purpose
This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and login to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer:	Eaknarin Puangsopa
Logged On User Name:	eaknarin_puangsope@agilent.com
Signature Creation Date:	January 5, 2024
Reason for Signature:	Executed protocol and published this original version of document

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

User Name: eaknarin_puangsope

Report Generated by Hostname: ASRYG0W0574

System ID: RYG_EN0136

Print Date: January 5, 2024 10:53:25 AM

ALB_OO_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:37:31 AM	Auth	SessionCreated	Session	None
January 4, 2024 10:37:31 AM	Start	Configuration	Session	None
January 4, 2024 10:37:31 AM	Auth	Enrollment	Licensing	User is Field Engineer and does not require an unlock code
January 4, 2024 10:39:29 AM	Auth	ExpLoaded	Session	EOP details for primary technique (G4) - File path: [ProtocolPackage\Software\Config\user\02.54\02.54\02.54.aug], EOP File Name: [02.54.aug], EOP Name: [AgilentRecommended], Protocol Revision: [02.02.54], EOP details for hyphenated technique (G4H) - File path: [ProtocolPackage\Software\Config\user\02.54\02.54\02.54.aug], EOP File Name: [02.54.aug], EOP Name: [AgilentRecommended]
January 4, 2024 10:39:40 AM	End	Configuration	Session	None
January 4, 2024 10:39:44 AM	Start	Qualification	Session	OQ
January 4, 2024 10:39:44 AM	Start	Execution	CDS Login Verification - GC - 7890: - Qualitative test	None
January 4, 2024 10:46:00 AM	End	Execution	CDS Login Verification - GC - 7890: - Qualitative test	Run Count : 1

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

User Name: eaknarin_puangsoopa
Report Generated by Hostname: ASRYQW0074

System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OO_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:45:05 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No sample(s) associated	None
January 4, 2024 10:45:18 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No sample(s) associated	Run Count: 1
January 4, 2024 10:46:22 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
January 4, 2024 10:48:52 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
January 4, 2024 10:48:54 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
January 4, 2024 10:51:05 AM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
January 4, 2024 10:51:06 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
January 4, 2024 10:51:43 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
January 4, 2024 10:56:43 AM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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User Name: eaknarin_puangsoopa
Report Generated by Hostname: ASRYQW0074

System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OO_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:58:48 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
January 4, 2024 10:58:59 AM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
January 4, 2024 11:25:26 AM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
January 4, 2024 11:25:28 AM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
January 4, 2024 11:25:39 AM	Start	Execution	Log Amp - 59778 EQ - Source: None EI - Extractor	None
January 4, 2024 11:43:23 AM	End	Execution	Log Amp - 59778 EQ - Source: None EI - Extractor	Run Count: 1
January 4, 2024 11:43:26 AM	Start	Execution	RPPA - 59778 EQ - Source: EI None - Extractor	None
January 4, 2024 11:53:23 AM	End	Execution	RPPA - 59778 EQ - Source: EI None - Extractor	Run Count: 1
January 4, 2024 11:53:28 AM	Start	Execution	Turn EI - 59778 EQ - Source: None EI - Extractor Filament 1 (Qualitative - No sample(s) associated)	None
January 4, 2024 1:37:28 PM	End	Execution	Turn EI - 59778 EQ - Source: None EI - Extractor Filament 1 (Qualitative - No sample(s) associated)	Run Count: 1
January 4, 2024 1:37:28 PM	Start	Execution	Turn EI - 59778 EQ - Source: None EI - Extractor Filament 2 (Qualitative - No sample(s) associated)	None

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User Name: eaknarin_puangsoopa
Report Generated by Hostname: ASRYQW0074

System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OO_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 1:48:59 PM	End	Execution	Turn EI - 59778 EQ - Source: None EI - Extractor Filament 2 (Qualitative - No sample(s) associated)	Run Count: 1
January 4, 2024 1:49:02 PM	Start	Execution	Scouting Run - Manual Injection, Front SSL, EQ - Source: EI - Extractor - Part of GCMS System Preparation	None
January 4, 2024 2:20:35 PM	Audit	Not Closed	Session	None
January 5, 2024 8:28:16 AM	Audit	Not Started	Session	None
January 5, 2024 8:28:18 AM	Audit	Session Reloading	Session	None
January 5, 2024 8:28:29 AM	Start	Qualification	Session	OQ
January 5, 2024 8:28:28 AM	Start	Execution	Scouting Run - Manual Injection, Front SSL, EQ - Source: EI - Extractor - Part of GCMS System Preparation	None
January 5, 2024 9:21:29 AM	Audit	Data	Scouting Run - Manual Injection, Front SSL, EQ - Source: EI - Extractor - Part of GCMS System Preparation	Data File Path: D:\OQ2024\count1.D
January 5, 2024 9:21:53 AM	End	Execution	Scouting Run - Manual Injection, Front SSL, EQ - Source: EI - Extractor - Part of GCMS System Preparation	Run Count: 1
January 5, 2024 9:21:53 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None

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User Name: eaknarin_puangsoopa
Report Generated by Hostname: ASRYQW0074

System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OO_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 5, 2024 9:25:59 AM	End	Qualification	Session	OQ
January 5, 2024 9:26:39 AM	Start	Reporting	Session	None
January 5, 2024 9:27:46 AM	End	Reporting	Session	None
January 5, 2024 9:27:45 AM	Start	Qualification	Session	OQ
January 5, 2024 9:27:46 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
January 5, 2024 9:33:18 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Data File Path: D:\OQ2024\SN_F1.D
January 5, 2024 9:45:22 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count: 1
January 5, 2024 9:46:32 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 2 - L: >= 1200	None
January 5, 2024 9:46:15 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Data File Path: D:\OQ2024\SN_F2.D
January 5, 2024 10:00:19 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, EQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count: 1

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User Name: eahnarin_juangscope Report Generated by Hostname: ASRYGW0074 ALS_OO_RYG_EN0136 Transaction log :				
System ID: RYG_EN0136 Print Date: January 5, 2024 10:53:25 AM				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 5, 2024 10:53:53 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Deviation flag for Run Count : 1
January 5, 2024 10:53:53 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	None
January 5, 2024 10:12:48 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Data file Path : D:\OQ2024\EN_F00.D
January 5, 2024 10:17:58 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Run Count : 2
January 5, 2024 10:22:54 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Deviation flag for Run Count : 3
January 5, 2024 10:22:54 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	None
January 5, 2024 10:22:15 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Data file Path : D:\OQ2024\EN_F00.D
January 5, 2024 10:25:27 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Run Count : 3

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User Name: eahnarin_juangscope Report Generated by Hostname: ASRYGW0074 ALS_OO_RYG_EN0136 Transaction log :				
System ID: RYG_EN0136 Print Date: January 5, 2024 10:53:25 AM				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 5, 2024 10:25:11 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Deviation flag for Run Count : 3
January 5, 2024 10:28:11 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	None
January 5, 2024 10:42:05 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Data file Path : D:\OQ2024\EN_F00.D
January 5, 2024 10:46:54 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ2 - Source: EI - Extractor using Filament 2 - L1 => 1200	Run Count : 4
January 5, 2024 10:46:41 AM	End	Qualification	Session	QQ
January 5, 2024 10:46:41 AM	Start	Reporting	Session	None
January 5, 2024 10:50:27 AM	Audit	Reporting	Session	Report Generated : Certificate
January 5, 2024 10:51:07 AM	Audit	Reporting	Session	Report Generated : Report
January 5, 2024 10:51:29 AM	Audit	Reporting	Session	Report Generated : Certificate
January 5, 2024 10:52:00 AM	Audit	Reporting	Session	Report Generated : Report

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System ID: RYG_EN0136

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
710/00117 SUBSISTENSI KADES D. LAMBU, BANGKALU
AMPOL BANGKALU SAMUTRAKARN PROVINCE 10540 THAILAND
TEL : 0866921867 FAX : 0866921867



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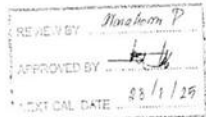
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INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
710/00117 SUBSISTENSI KADES D. LAMBU, BANGKALU
AMPOL BANGKALU SAMUTRAKARN PROVINCE 10540 THAILAND
TEL : 0866921867 FAX : 0866921867



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Certificate of Calibration

Customer: ALS Laboratory Group Thailand Co., Ltd.
Name: 164 Soi Phatthamkarn 40, Phatthamkarn Road, Suan Luang, Bangkok
Address: 10250
Unit Under Calibration Details:
Measurement Item: Air Flow Meter
Manufacturer: Bios
Model: Defender 510 L
Serial Number: 206895
ID: BKK_FSI346
Location of Calibration: LAB 4 AIR VELOCITY METRIC
Calibration Environment and Details:
Temperature: 23.1°C ± 0.5°C
Humidity: 55%RH ± 20%RH
Barometric Pressure: 1013 hPa ± 10 hPa
Received Date: 3 January 2024
Calibration Date: 29 January 2024
Calibration Procedure: In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator



Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	1850101006	Sensodyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	1401011003	Sensodyne	12 July 2024
Temperature meter	GT 11	06010657	Qidown	27 February 2024
Pressure meter	CPC2-R0P	41100KDL/651942	TPA	9 November 2024

Traceability:

This Certificate is traceable to SI Unit through Sensodyne AZLA Accreditation No. 1943.01

Note:

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

This Certificate was issued to replace in Calibration Certificate No. 24-AFM-018

Calibration By: Mr. Noppadon Luangart
Service Calibration Engineer

Approved By: Mr. Paitit Mulkavim
Calibration Engineer Supervisor
Issue Date: 1 February 2024

Certificate No : 24-AFM-018 Rev 1

Request No : Req-2024-0043

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (ml/min)	UUC ^a (ml/min)	Error (ml/min)	Uncertainty (ml/min)
25.00	101.66	20	20.148	0.1	1.3
25.00	101.67	100	99.409	-0.6	2.8
24.90	101.63	199	197.46	-1.5	5.6
25.00	101.61	300	298.15	-1.8	8.4
24.90	101.60	399	400.13	1	11
24.90	101.59	480	478.02	-2.0	6.8

Note:

STD: Standard UUC: Unit Under Calibration

^a UUC Reference Condition: At atmospheric pressure and room temperature condition^b Flow Rate was corrected for non-standard operating condition by using equation:

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where: Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate



Calibration Certificate

Certificate No. 610563
Product 200-510M Defender 510 Medium Flow
Serial No. 151114
Cal. Date 21-May-2024

Sold To:

All calibrations are performed in accordance with ISO 17025 at Mesa Laboratories, Inc., 12100 W. 6th Ave, Lakewood, CO 80228, an ISO 17025:2017 accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

As Received Calibration Data

Technician	Derek Dellape	Lab. Pressure Lab. Temperature	614.2 mmHg 24.3 °C	Instrument Reading	Lab. Standard Reading	Deviation	Allowable Deviation	As Received
0 ccm				4504.81 ccm		-100.0%	1.00%	Out of Tolerance
0 ccm				1000.95 ccm		-100.0%	1.00%	Out of Tolerance
0 ccm				249.55 ccm		-100.0%	1.00%	Out of Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	117991	13-Nov-2023	13-Nov-2024

As Shipped Calibration Data

Certificate No	610563	Lab. Pressure	617 mmHg	
Technician	Derek Dellape	Lab. Temperature	24.6 °C	
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4482.47 ccm	4493.49 ccm	-0.25%	1.00%	In Tolerance
997.25 ccm	996.83 ccm	0.04%	1.00%	In Tolerance
248.51 ccm	248.67 ccm	-0.06%	1.00%	In Tolerance

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	211053	04-Oct-2023	04-Oct-2024

Calibration Notes

The expanded uncertainty of flow has a coverage factor of $k = 2$ for a confidence interval of approximately 95%.
Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.
Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

By:

Approved By:

Derek Dellape
Production Assembler II

Troy Thacker
Quality Engineer

Mesa Laboratories, Inc. certifies that the above instrument meets or exceeds published specifications, and that the calibration results in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Calibration results are in compliance with ISO/IEC 17025:2017. Calibration process has a Test Uncertainty Ratio (TUR) of 4.1 or greater. Any Pass/Fail determination is made without taking measurement uncertainty into account and is based on UUT performance against required tolerance only.

Mesa Laboratories Inc. 12100 W. 6th Ave. Lakewood, CO 80228 USA
(303) 997-6000 www.mesalabs.com Symbol "MLAB" on the NASDAQ

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
719 MOO 13, SOI SUTSAKORN II TAMBON BANG KALU
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL : 0600 21165500 FAX : 0600 21167140



INNOVATIVE INSTRUMENT CALIBRATION LAB
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AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL : 0600 21165500 FAX : 0600 21167140



Certificate of Calibration

Customer ALS Laboratory Group Thailand Co., Ltd.
Name ALS Laboratory Group Thailand Co., Ltd.
Address 104 Soi Phantakan 40, Phantakan Road, Suan Luang, Bangkok 10250
Unit Under Calibration Details
Measurement Item Primary Flow Calibrator
Manufacturer Bios
Model Defender 510-4
Serial Number 130037
ID RYG_FS0208
Location of Calibration LAB 4 AIR VOLUME METER
Calibration Environment and Details
Temperature 23 °C ± 3 °C
Humidity 55 %RH ± 20 %RH
Barometric Pressure 1013 hPa ± 10 hPa
Received Date 31 January 2024
Calibration Date 13 February 2024
Calibration Procedure In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low Flow	15501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard Flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	08000057	Orechem	27 February 2024
Pressure meter	CPG2400	41000KDU1651x2	TPA	9 November 2024

Traceability:

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note:

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

Calibration By:
Mr. Noppadol Laungnari
Service Calibration Engineer

Approved By:
Mr. Panch Mahavien
Calibration Engineer Supervisor
Issue Date: 13 February 2024

Certificate No : 24-AFM-033
Request No : Req-2024-0241

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
24.50	101.26	20	19.965	0.0	1.3
24.20	101.25	101	100.50	-0.5	2.8
24.00	101.31	200	199.13	-0.9	5.6
23.90	101.42	301	303.56	2.6	8.4
24.10	101.41	401	404.57	4	11
24.10	101.46	450	453.81	3.8	7.0

Note:

STD : Standard UUC : Unit Under Calibration

UUC Reference Condition : At atmospheric pressure and room temperature condition

Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

Certificate of Calibration

Customer
Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthakan 40, Phatthakan Road, Suan Luang, Bangkok 10250

Unit Under Calibration Details
Measurement Item : Primary Flow Calibrator
Manufacturer : Bux
Model : Defender 510-M
Serial Number : 129958
ID : RYG_FS0209

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details
Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 31 January 2024
Calibration Date : 13 February 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensodyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensodyne	12 July 2024
Temperature meter	GT 11	08000057	Qtechom	27 February 2024
Pressure meter	CPG2400	41000KDU/651592	TPA	9 November 2024

Traceability :
This Certificate is traceable to SI Unit through Sensodyne AZLA Accreditation No. 1943-01
Note :
The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibration By : 
Mr. Noppadol Luangari
Service Calibration Engineer

Approved By : 
Mr. Pait Mahavarn
Calibration Engineer Supervisor

Issue Date : 13 February 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 01 Issue date 25/01/24

Certificate No : 24-AFM-032
Request No : Req-2024-0240

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
23.80	101.89	95	160.13	5.1	2.8
23.90	101.71	501	513.93	12.9	7.2
24.18	101.62	1006	1019.3	13	14
24.60	101.81	1997	2023.0	26	29
24.10	101.87	2999	3035.5	37	45
24.60	102.00	3944	3991.8	48	59
24.60	102.08	4739	4790.5	52	72

Note
STD : Standard UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for non-standard operating condition by using equation

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 01 Issue date 25/01/24

Certificate of Calibration

Customer
Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthakan 40, Phatthakan Road, Suan Luang, Bangkok 10250

Unit Under Calibration Details
Measurement Item : Air Flow Meter
Manufacturer : MesaLabs
Model : 510-M
Serial Number : 200345
ID : BKK_FSI347

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details
Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 22 August 2024
Calibration Date : 28 August 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensodyne	6 August 2025
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensodyne	2 August 2025
Temperature meter	GT 11	08000057	Qtechom	1 March 2025
Pressure meter	CPG2400	41000KDU/651592	TPA	9 November 2024

Traceability :
This Certificate is traceable to SI Unit through Sensodyne AZLA Accreditation No. 1943-01
Note :
The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibration By : 
Mr. Noppadol Luangari
Service Calibration Engineer

Approved By : 
Mr. Pait Mahavarn
Calibration Engineer Supervisor

Issue Date : 28 August 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 04 Issue date 17/6/24

Certificate No : 24-AFM-174
Request No : Req-2024-1861

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)	MPE (cc/min)	Result
22.30	100.57	100	99.526	-0.5	2.8	1	N/A
22.40	100.61	499	509.48	1.5	7.8	5	N/A
22.50	100.56	1004	1004.8	1	15	10	N/A
22.60	100.54	2008	2003.3	-0.5	29	20	N/A
22.80	100.62	3034	3032.1	-0.2	45	30	N/A
23.20	100.71	4032	4022.4	-10	60	40	N/A
23.40	100.73	8609	8586.4	-24	79	51	N/A

Note
STD : Standard UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for non-standard operating condition by using equation

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available (Customer does not require a statement of conformity)

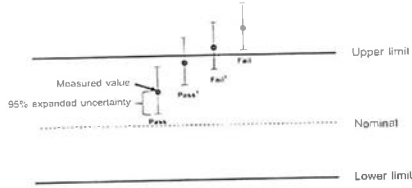
The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 04 Issue date 17/6/24

Certificate No : 24-AFM-174
Request No : Req-2024-1861

Decision Rule for Statements of Conformity

The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-GS-09 2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

- Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.
Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.
Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.
Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate of Calibration

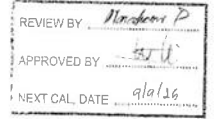
Customer
Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Unang, Bangkok 10250

Certificate No : 24-AFM-177
Request No : Req-2024-1862

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : Bios
Model : Defender 510-L
Serial Number : 130026
ID : BKS_F50619
Location of Calibration : LAB-4 AIR VELOCITY METER
Calibration Environment and Details
Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 22 August 2024
Calibration Date : 9 September 2024
Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Accuracy : ± % of Reading
Sensor Model :
Sensor Serial Number :
Instrument Status : Used



Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Calibrator 3 Low flow	18501010006	Sensidyne	6 August 2025
Air Flow Meter	Calibrator 5 Standard flow	19031011603	Sensidyne	2 August 2025
Temperature meter	GT 11	05000657	Oreborn	1 March 2025
Pressure meter	CTG2400	41000KJUG61832	TFA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

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

Calibration By :
Mr. Norpadon Lueangm
Service Calibration Engineer

Approved By :
Mr. Paeit Mathayom
Calibration Engineer Supervisor
Issue Date : 9 September 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate No : 24-AFM-177
Request No : Req-2024-1862

Result of Calibration : Without Adjustment

Temperature	Pressure	STD	ULC ¹	Error	Uncertainty	MPE	Result
(°C)	(kPa)	(cc/min)	(cc/min)	(cc/min)	(cc/min)	(cc/min)	
24.70	100.92	26	20.192	0.2	1.3	0.2	N/A
24.70	100.90	109	99.923	-0.1	2.5	1.0	N/A
24.70	100.94	201	200.7	-0.3	5.6	2.0	N/A
24.70	100.97	298	300.1	2.1	8.4	3.0	N/A
24.70	100.99	403	399.1	-4	11	4.0	N/A
24.80	101.05	482	472.6	-4.4	6.9	4.8	N/A

Note : STD = Standard ULC = Unit Under Calibration
- ULC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for nonstandard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where : Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specification)

N/A = Not Assailable, Customer does not require a statement of conformity.

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

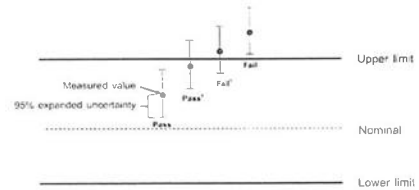
FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate No : 24-AFM-177
Request No : Req-2024-1862

Decision Rule for Statements of Conformity

The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-GS-09 2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

- Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.
Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.
Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.
Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24



ROTA METER CALIBRATION RESULT JULY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	01 Jul 24	$Y = 1.0001x + 0.0433$	1.0000
BKK_FS0584	01 Jul 24	$Y = 1.0056x - 2.7974$	1.0000
BKK_FS0585	02 Jul 24	$Y = 1.0315x + 3.0033$	0.9998
BKK_FS0587	02 Jul 24	$Y = 1.0294x + 0.71$	1.0000
BKK_FS0588	01 Jul 24	$Y = 0.9751x + 9.8452$	0.9999
BKK_FS0591	01 Jul 24	$Y = 1.0035x - 8.2303$	1.0000
BKK_FS0592	02 Jul 24	$Y = 1.002x + 14.273$	1.0000
BKK_FS0594	02 Jul 24	$Y = 1.0003x + 7.0095$	1.0000
BKK_FS0595	01 Jul 24	$Y = 1.0871x - 114.87$	0.9985
BKK_FS1004	02 Jul 24	$Y = 0.9826x + 13.51$	0.9999
BKK_FS1005	02 Jul 24	$Y = 1.0217x - 0.5833$	0.9997
BKK_FS1006	02 Jul 24	$Y = 1.149x - 1.0422$	0.9981
BKK_FS1007	02 Jul 24	$Y = 1.1116x + 3.3558$	0.9994
BKK_FS1008	02 Jul 24	$Y = 1.1273x + 0.4837$	0.9999
BKK_FS1009	01 Jul 24	$Y = 1.1044x - 0.8245$	1.0000
BKK_FS1017	02 Jul 24	$Y = 1.0488x + 2.2027$	0.9998
BKK_FS1018	02 Jul 24	$Y = 1.0173x - 0.1967$	0.9999
BKK_FS1019	02 Jul 24	$Y = 1.0022x + 5.619$	1.0000
BKK_FS1026	01 Jul 24	$Y = 1.072x - 2.4954$	1.0000
BKK_FS1027	01 Jul 24	$Y = 1.0104x - 4.4788$	0.9999
BKK_FS1028	01 Jul 24	$Y = 1.0009x - 3.7755$	1.0000
BKK_FS1029	01 Jul 24	$Y = 1.1118x - 4.4431$	0.9965
BKK_FS1030	01 Jul 24	$Y = 1.0159x - 6.395$	1.0000
BKK_FS1031	01 Jul 24	$Y = 0.9973x - 5.3371$	0.9999
BKK_FS1039	02 Jul 24	$Y = 0.9992x + 9.6833$	0.9992
BKK_FS1040	01 Jul 24	$Y = 1.0034x - 2.5343$	1.0000
BKK_FS1041	02 Jul 24	$Y = 1.0511x + 1.1272$	0.9996
BKK_FS1042	02 Jul 24	$Y = 1.0016x + 10.387$	0.9995
BKK_FS1043	01 Jul 24	$Y = 0.9965x + 9.3743$	1.0000
BKK_FS1044	02 Jul 24	$Y = 1.1237x - 0.4231$	0.9981
BKK_FS1200	01 Jul 24	$Y = 1.0337x - 0.1016$	0.9994
BKK_FS1201	01 Jul 24	$Y = 0.9871x + 5.0931$	0.9986
BKK_FS1202	01 Jul 24	$Y = 0.7978x + 301.39$	0.9334
PHK_FS0027	02 Jul 24	$Y = 1.0722x + 3.4395$	0.9988
PHK_FS0028	02 Jul 24	$Y = 1.0254x + 1.04$	1.0000
PHK_FS0029	02 Jul 24	$Y = 0.999x + 12.73$	1.0000
RYG_FS0197	01 Jul 24	$Y = 1.0045x + 10.291$	1.0000
RYG_FS0198	01 Jul 24	$Y = 1.0056x + 1.8883$	1.0000
RYG_FS0199	02 Jul 24	$Y = 1.0029x + 3.2381$	0.9990



ROTA METER CALIBRATION RESULT JULY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
RYG_FS0654	02 Jul 24	$Y = 1.0421x + 1.4935$	1.0000
RYG_FS0655	02 Jul 24	$Y = 0.975x + 15.2$	0.9994
RYG_FS0656	01 Jul 24	$Y = 1.0042x + 7.1067$	0.9999
RYG_FS0657	02 Jul 24	$Y = 1.0337x + 1.8918$	0.9998
RYG_FS0658	02 Jul 24	$Y = 0.9921x + 10.87$	0.9996
RYG_FS0659	01 Jul 24	$Y = 1.0022x + 8.4152$	1.0000
SGK_FS0135	02 Jul 24	$Y = 1.0193x + 3.6833$	0.9999
SGK_FS0136	02 Jul 24	$Y = 1.0217x + 1.63$	1.0000
SGK_FS0138	02 Jul 24	$Y = 1.055x + 4.5833$	0.9999
SGK_FS0139	02 Jul 24	$Y = 1.0154x + 3.74$	0.9996
SGK_FS0140	02 Jul 24	$Y = 1.0008x + 13.353$	1.0000
SGK_FS0141	02 Jul 24	$Y = 1.1185x + 1.4867$	0.9998
SGK_FS0142	02 Jul 24	$Y = 1.0211x + 1.39$	1.0000
SGK_FS0143	02 Jul 24	$Y = 1.0045x + 5.6981$	1.0000

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

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



ROTA METER CALIBRATION RESULT OCTOBER 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0573	02 Oct 24	$Y = 1.0146x + 4.4306$	1.0000
BKK_FS0577	02 Oct 24	$Y = 1.1097x + 3.8082$	0.9994
BKK_FS0584	02 Oct 24	$Y = 1.0163x + 3.55$	0.9997
BKK_FS0585	02 Oct 24	$Y = 1.0324x + 2.63$	0.9997
BKK_FS0587	02 Oct 24	$Y = 1.029x + 1.25$	0.9999
BKK_FS0591	02 Oct 24	$Y = 1.0002x + 15.177$	1.0000
BKK_FS0592	02 Oct 24	$Y = 1.0003x + 15.506$	1.0000
BKK_FS0594	02 Oct 24	$Y = 1.0024x + 7.9314$	1.0000
BKK_FS1006	02 Oct 24	$Y = 1.0705x + 3.1952$	1.0000
BKK_FS1007	02 Oct 24	$Y = 1.0983x + 4.1833$	0.9998
BKK_FS1008	02 Oct 24	$Y = 1.1231x + 0.8782$	0.9988
BKK_FS1017	02 Oct 24	$Y = 1.0361x + 2.7864$	0.9998
BKK_FS1018	02 Oct 24	$Y = 1.0137x + 0.9333$	1.0000
BKK_FS1019	02 Oct 24	$Y = 1.0016x + 6.9648$	1.0000
BKK_FS1026	02 Oct 24	$Y = 1.1424x - 0.8571$	0.9975
BKK_FS1027	02 Oct 24	$Y = 1.0293x + 3.5233$	1.0000
BKK_FS1028	02 Oct 24	$Y = 1.0028x + 9.8067$	1.0000
BKK_FS1039	02 Oct 24	$Y = 1.0041x + 9.1033$	0.9993
BKK_FS1040	02 Oct 24	$Y = 1.0025x + 1.1619$	1.0000
BKK_FS1041	02 Oct 24	$Y = 1.0352x + 1.6626$	1.0000
BKK_FS1042	02 Oct 24	$Y = 1.0015x + 11.25$	0.9995
BKK_FS1044	02 Oct 24	$Y = 1.1163x + 0.7323$	0.9973
PHK_FS0027	02 Oct 24	$Y = 1.0849x + 3.3133$	0.9991
PHK_FS0028	02 Oct 24	$Y = 1.0257x + 1.5667$	0.9999
PHK_FS0029	02 Oct 24	$Y = 0.9989x + 14.706$	1.0000
RYG_FS0195	02 Oct 24	$Y = 1.0031x + 10.024$	1.0000
RYG_FS0196	02 Oct 24	$Y = 1.0047x + 8.6114$	1.0000
RYG_FS0197	02 Oct 24	$Y = 1.0049x + 10.074$	1.0000
RYG_FS0198	02 Oct 24	$Y = 1.0051x + 3.3883$	1.0000
RYG_FS0199	02 Oct 24	$Y = 1.0349x + 2.3983$	0.9993
RYG_FS0627	02 Oct 24	$Y = 1.0162x + 6.0933$	0.9999
RYG_FS0628	02 Oct 24	$Y = 1.0035x + 7.8667$	0.9999
RYG_FS0654	02 Oct 24	$Y = 1.0541x + 2.2446$	0.9999
RYG_FS0655	02 Oct 24	$Y = 0.9734x + 17.51$	0.9997
RYG_FS0656	02 Oct 24	$Y = 1.0034x + 6.661$	0.9999
RYG_FS0657	02 Oct 24	$Y = 1.0322x + 4.2303$	0.9999
RYG_FS0658	02 Oct 24	$Y = 0.9945x + 10.98$	0.9996
RYG_FS0659	02 Oct 24	$Y = 1.0022x + 9.2876$	1.0000
SGK_FS0135	02 Oct 24	$Y = 1.0203x + 3.7733$	0.9999



ROTA METER CALIBRATION RESULT OCTOBER 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
SGK_FS0136	02 Oct 24	$Y = 1.0313x - 1.0933$	0.9999
SGK_FS0138	02 Oct 24	$Y = 1.0479x + 5.8214$	1.0000
SGK_FS0139	02 Oct 24	$Y = 1.0166x + 4.0367$	0.9998
SGK_FS0140	02 Oct 24	$Y = 1.0006x + 14.979$	1.0000
SGK_FS0141	02 Oct 24	$Y = 1.0846x + 3.8398$	1.0000
SGK_FS0142	02 Oct 24	$Y = 1.0211x + 2.0233$	1.0000
SGK_FS0143	02 Oct 24	$Y = 1.0042x + 6.461$	1.0000

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

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

Certificate of System Qualification

GC-OQ

System ID: CN11461066
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Soi 40 Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250

Date: April 21, 2023 3:26:38 PM
EQP Name: Agilent Recommended
EQP Revision: GC.02.52
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: Saengulhal Tarak

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: -0.1 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

Date: April 21, 2023 3:26:38 PM

System ID: CN11461066

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Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Setpoint Status: Pass

Inlet Pressure: 25.0 psi

Actual: 25.2 psi

Accuracy: 0.2 psi

Agilent Recommended: ≤ 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name: 7890

Back SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: 0.0 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Back SSL

Date: April 21, 2023 3:26:38 PM

System ID: CN11461066

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Setpoint Status:

Pass

Inlet Pressure: 25.0 psi

Actual: 24.8 psi

Accuracy: 0.2 psi

Agilent Recommended: ≤ 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Front FID

Setpoint Status: Pass

Flow Type: Fuel

Setpoint: 30.0 mL/min

Measured Flow: 28.9 mL/min

Accuracy: 1.1 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (3.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Oxidizer

Setpoint: 400.0 mL/min

Measured Flow: 400 mL/min

Accuracy: 0.0 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (40.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Makeup

Setpoint: 25.0 mL/min

Measured Flow: 24.8 mL/min

Accuracy: 0.1 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (2.5 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

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System ID: CN11461066

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Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Back FID

Setpoint Status: Pass

Flow Type: Fuel

Setpoint: 30.0 mL/min

Measured Flow: 30.7 mL/min

Accuracy: 0.7 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (3.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Oxidizer

Setpoint: 400.0 mL/min

Measured Flow: 399 mL/min

Accuracy: 1.0 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (40.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Makeup

Setpoint: 25.0 mL/min

Measured Flow: 24.6 mL/min

Accuracy: 0.4 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (2.5 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Date: April 21, 2023 3:26:38 PM

System ID: CN11461066

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Setpoint Status: **Pass**
Zone: **Oven**
Setpoint/Actual
Temperature: **230.0** **230.6** °C
Accuracy: **0.6** °C
Agilent Recommended: **>= -1.0** % setpoint in K (**-5.0** °C)
<= 1.0 % setpoint in K (**5.0** °C)

Setpoint Status: **Pass**
Zone: **Oven**
Setpoint/Actual
Temperature: **100.0** **100.9** °C
Accuracy: **0.9** °C
Agilent Recommended: **>= -1.0** % setpoint in K (**-3.7** °C)
<= 1.0 % setpoint in K (**3.7** °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: **7890**
Setpoint Status: **Pass**
Setpoint/Average
Temperature: **100.0** **100.8833** °C
Stability: **0.1** °C
Agilent Recommended: **<= 0.5**

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1 **Front** **SSL** / **Front** **FID**
Injection Tower
Name: **7893A**

Date: April 21, 2023 3:26:38 PM
System ID: CN11461068

Setpoint Status: **Completed**
Injection Volume on Column: **1.0** µL
Overall Scouting Run Status
Completed

Noise and Drift

Tested Combination1 **Front** **SSL** / **Front** **FID**
Name: **7890**
Setpoint Status: **Pass**
Base Signal: **22.7** pA
ASTM Noise **0.06** pA
Drift **0.05** pA/hr
Agilent Recommended: **<= 0.10** pA
Pass **Pass**

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1 **Front** **SSL** / **Front** **FID**
Name: **7893A**
Setpoint Status: **Pass**
Injection Volume on Column: **1.0** µL
Area RSD: **0.32** %
Retention Time RSD: **0.67** %
Agilent Recommended: **<= 3.00** % **<= 1.00** %

Overall Injection Precision Test Status

Pass

Signal to Noise

Date: April 21, 2023 3:26:38 PM
System ID: CN11461068

Tested Combination1 **Front** **SSL** / **Front** **FID**
Injection Tower
Name: **7890**
Setpoint Status: **Pass**
Signal to Noise: **721755**
Agilent Recommended: **>= 300000**

Overall Signal to Noise Test Status

Pass

Scouting Run

Tested Combination2 **Back** **SSL** / **Back** **FID**
Injection Tower
Name: **7893A**

Setpoint Status: **Completed**
Injection Volume on Column: **1.0** µL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination2 **Back** **SSL** / **Back** **FID**
Name: **7890**
Setpoint Status: **Pass**
Base Signal: **22.6** pA
ASTM Noise **0.07** pA
Drift **0.09** pA/hr
Agilent Recommended: **<= 0.10** pA
Pass **Pass**

Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2 **Back** **SSL** / **Back** **FID**
Name: **7893A**
Setpoint Status: **Pass**
Injection Volume on Column: **1.0** µL
Area RSD: **1.28** %
Retention Time RSD: **0.83** %
Agilent Recommended: **<= 3.00** % **<= 1.00** %

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2 **Back** **SSL** / **Back** **FID**
Injection Tower
Name: **7890**
Setpoint Status: **Pass**
Signal to Noise: **2404398**
Agilent Recommended: **>= 300000**

Overall Signal to Noise Test Status

Pass

Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System	
System ID	CN11461066
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging
Tested Combination1	
Injection Technique	Injection Tower
Sampler Identifier	Sampler 2
Inlet	Front
Detector	Front
LTM Included?	No
Tested Combination2	
Injection Technique	Injection Tower
Sampler Identifier	Sampler 3
Inlet	Back
Detector	Back
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Tray
Name	7893A
Model Number	G4514A
Serial Number	CN15380030
Firmware Revision	A.11.01
Vial Heater	Not Installed

Sampler 2	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7893A
Model Number	G4513A
Serial Number	CN16280128
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10
Sampler 3	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7893A
Model Number	G4513A
Serial Number	CN10340103
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Back
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	Version 4.27
Oven Type	Standard

Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Inlet 2	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen
Detector 2	
Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Back
Makeup Gas	Nitrogen

Electronic Signature

Purpose

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Details	
Full Name of Signer:	Saengulhal Tarak
Logged On User Name:	saengulhal.tarak@non.agilent.com
Signature Creation Date:	April 21, 2023
Reason for Signature:	Executed protocol and published this original version of document

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GC-5_BKK_EN0127_ALB Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:21:36 AM	Audit	Session Created	Session	None
April 21, 2023 11:21:36 AM	Start	Configuration	Session	None
April 21, 2023 11:21:36 AM	Audit	Entitlement	Licensing	User Is Nonpaying and does not require an unlock code.
April 21, 2023 11:22:04 AM	Audit	Exploited	Session	EOP details for primary multiparty [Eq] - File path: <code>[Process]\Packs\Gsc\Config\bra\02_52\Gsc\02_52_eq.p</code> EQIP File Name: <code>[Gc\02_52_eq.p]</code> , EOP Name: <code>[qAgentRecommended_ProtocolRevision/Gc-02_52]</code>
April 21, 2023 11:22:06 AM	End	Configuration	Session	None
April 21, 2023 11:22:14 AM	Start	Qualification	Session	OQ
April 21, 2023 11:22:14 AM	Start	Execution	CDS Logon Verification - GC -	None - Qualitative test
April 21, 2023 11:23:14 AM	End	Execution	CDS Logon Verification - GC -	Run Count: 1 - Qualitative test
April 21, 2023 11:23:16 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7800-	None Qualitative Test - No symptoms associated
April 21, 2023 11:23:35 AM	End	Execution	System Inspection and Basic Safety and Operation - 7800-	Run Count: 1 Qualitative Test - No symptoms associated
April 21, 2023 11:23:37 AM	Start	Execution	Hat Pressure Decay - Fort SSB -	None S: 33.0 psi + L: >= -2.0 psi and <= 0.8 psi

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System ID: CN11461066

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461060

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Agilent CrossLab Compliance Services

OC-6_BKK_EN0127_ALS Transaction log :

Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:25:26 AM	Start	Execution	Detectior Flow Accuracy - Front FID - Type : Outlier - S: 430.0 mL/min - L <= 10.0% suspect	None
April 21, 2023 11:25:40 AM	End	Data	Detectior Flow Accuracy - Front FID - Type : Outlier - S: 430.0 mL/min - L <= 10.0% suspect	Manual Data Entry
April 21, 2023 11:25:42 AM	End	Execution	Detectior Flow Accuracy - Front FID - Type : Outlier - S: 430.0 mL/min - L <= 10.0% suspect	Run Count : 1
April 21, 2023 11:25:44 AM	Start	Execution	Detectior Flow Accuracy - Front FID - Type : Midlow - S: 25.0 mL/min - L <= 10.0% suspect	None
April 21, 2023 11:26:01 AM	End	Data	Detectior Flow Accuracy - Front FID - Type : Midlow - S: 25.0 mL/min - L <= 10.0% suspect	Manual Data Entry
April 21, 2023 11:26:04 AM	End	Execution	Detectior Flow Accuracy - Front FID - Type : Midlow - S: 25.0 mL/min - L <= 10.0% suspect	Run Count : 1
April 21, 2023 11:26:05 AM	Start	Execution	Detectior Flow Accuracy - Back FID - Type : Front - S: 30.0 mL/min - L <= 10.0% suspect	None
April 21, 2023 11:26:19 AM	End	Data	Detectior Flow Accuracy - Back FID - Type : Front - S: 30.0 mL/min - L <= 10.0% suspect	Manual Data Entry
April 21, 2023 11:26:22 AM	End	Execution	Detectior Flow Accuracy - Back FID - Type : Front - S: 30.0 mL/min - L <= 10.0% suspect	Run Count : 1
April 21, 2023 11:26:24 AM	Start	Execution	Detectior Flow Accuracy - Back FID - Type : Outlier - S: 400.0 mL/min - L <= 10.0% suspect	None
April 21, 2023 11:26:38 AM	End	Data	Detectior Flow Accuracy - Back FID - Type : Outlier - S: 400.0	Manual Data Entry

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System ID: CN11461066

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GC-4_BKK_EN0127_ALB Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:28:43 AM	End	Execution	Detector Flow Accuracy - Back PID - Type: Outlier - S: 400.0 mL/min - L: <= 10.0% sag/pt	Run Count : 1
April 21, 2023 11:28:45 AM	Start	Execution	Detector Flow Accuracy - Back PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% sag/pt	None
April 21, 2023 11:27:01 AM	Audit	Data	Detector Flow Accuracy - Back PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% sag/pt	Manual Data Entry
April 21, 2023 11:27:05 AM	End	Execution	Detector Flow Accuracy - Back PID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% sag/pt	Run Count : 1
April 21, 2023 11:27:07 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= +1.0 AND <= 1.0 % sag/pt in K	None
April 21, 2023 11:27:33 AM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= +1.0 AND <= 1.0 % sag/pt in K	Manual Data Entry
April 21, 2023 11:27:35 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= +1.0 AND <= 1.0 % sag/pt in K	Run Count : 1
April 21, 2023 11:27:37 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 190.0°C - L: >= +1.0 AND <= 1.0 % sag/pt in K	None
April 21, 2023 11:27:54 AM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 190.0°C - L: >= +1.0 AND <= 1.0 % sag/pt in K	Manual Data Entry

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

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User Name: saangulhaLarak
Hostname: LAPTOP-G03BK0MV

System ID: CN11461066
Print Date: April 21, 2023 3:26:49 PM

GC-6_BKK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:27:57 AM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % specified in K	Run Count: 1
April 21, 2023 11:27:58 AM	Start	Execution	GC Oven Temperature Stability - 7800 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
April 21, 2023 11:28:07 AM	Auto	Data	GC Oven Temperature Stability - 7800 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
April 21, 2023 11:28:10 AM	End	Execution	GC Oven Temperature Stability - 7800 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
April 21, 2023 11:29:12 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:30:27 AM	Auto	Data	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:31:04 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Run Count: 1
April 21, 2023 11:31:07 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.60 pA/hour	None

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

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User Name: saangulhaLarak
Hostname: LAPTOP-G03BK0MV

System ID: CN11461066
Print Date: April 21, 2023 3:26:49 PM

GC-6_BKK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:31:43 AM	Auto	Data	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.60 pA/hour	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-35-08\FID1-D\FID1A.ch
April 21, 2023 11:32:09 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.60 pA/hour	Run Count: 1
April 21, 2023 11:32:03 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:32:23 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:33:55 AM	Auto	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:33:55 AM	Auto	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

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User Name: saangulhaLarak
Hostname: LAPTOP-G03BK0MV

System ID: CN11461066
Print Date: April 21, 2023 3:26:49 PM

GC-6_BKK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:33:55 AM	Auto	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:33:55 AM	Auto	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:33:59 AM	Auto	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:33:59 AM	Auto	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:35:00 AM	End	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
April 21, 2023 11:35:04 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	None

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

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User Name: saangulhaLarak
Hostname: LAPTOP-G03BK0MV

System ID: CN11461066
Print Date: April 21, 2023 3:26:49 PM

GC-6_BKK_EN0127_ALS Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:35:28 AM	Auto	Data	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1A.ch
April 21, 2023 11:36:00 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	Run Count: 1
April 21, 2023 11:36:03 AM	Start	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:36:36 AM	Auto	Data	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Data File Path : C:\Users\Public\Documents\ChromStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023-2023-04-20 14-36-08\FID1-D\FID1B.ch
April 21, 2023 11:37:30 AM	End	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Run Count: 1
April 21, 2023 11:37:32 AM	Start	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.60 pA/hour	None

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Date: April 21, 2023 3:26:38 PM
System ID: CN11461066

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User Name: saenguthai.larkh
Host Name: LAPTOP-CQ35RQWV

System ID: CN11461066
Print Date: April 21, 2023 3:28:40 PM

GC-4_BKK_EN0127_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:38:06 AM	Audit	Date	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/Year	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-20_14-38-06\FID-01-0058.D\FID 28.ch
April 21, 2023 11:38:23 AM	End	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/Year	Run Count: 1
April 21, 2023 11:38:32 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	None
April 21, 2023 11:38:51 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	None
April 21, 2023 11:40:17 AM	Audit	Date	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-21_10-37-32\FID11-0058.D\FID 28.ch
April 21, 2023 11:42:17 AM	Audit	Date	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-21_10-37-32\FID11-0058.D\FID 28.ch

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Date: April 21, 2023 3:28:38 PM
System ID: CN11461066

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User Name: saenguthai.larkh
Host Name: LAPTOP-CQ35RQWV

System ID: CN11461066
Print Date: April 21, 2023 3:28:40 PM

GC-4_BKK_EN0127_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:40:17 AM	Audit	Date	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-21_10-37-32\FID11-0058.D\FID 28.ch
April 21, 2023 11:40:17 AM	Audit	Date	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-21_10-37-32\FID11-0058.D\FID 28.ch
April 21, 2023 11:42:21 AM	Audit	Date	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-21_10-37-32\FID11-0058.D\FID 28.ch
April 21, 2023 11:43:21 AM	Audit	Date	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-21_10-37-32\FID11-0058.D\FID 28.ch
April 21, 2023 11:41:29 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Run Count: 1
April 21, 2023 11:41:33 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 100000	None

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Date: April 21, 2023 3:28:38 PM
System ID: CN11461066

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BKK_EN0126

User Name: saenguthai.larkh
Host Name: LAPTOP-CQ35RQWV

System ID: CN11461066
Print Date: April 21, 2023 3:28:40 PM

GC-4_BKK_EN0127_ALS Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:42:22 AM	Audit	Date	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	Data File Path: C:\Users\Public\Documents\ChromStation\Data\GC-4_BKK_EN0127_ALS_2023-04-20_14-38-06\FID-01-0058.D\FID28.ch
April 21, 2023 11:42:50 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	Run Count: 1
April 21, 2023 11:42:53 AM	End	Qualification	Session	OO
April 21, 2023 11:42:53 AM	Start	Reporting	Session	None
April 21, 2023 12:51:47 PM	Audit	AcqClosed	Session	None
April 21, 2023 2:16:07 PM	Audit	AcqRestarted	Session	None
April 21, 2023 2:16:10 PM	Audit	SessionReloaded	Session	None
April 21, 2023 2:16:31 PM	Start	Qualification	Session	OO
April 21, 2023 2:20:59 PM	Audit	AcqRestarted	Session	None
April 21, 2023 2:21:00 PM	Audit	SessionReloaded	Session	None
April 21, 2023 2:21:07 PM	Start	Qualification	Session	OO
April 21, 2023 2:25:45 PM	Audit	Reporting	Session	Report Generated: CertScan

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Date: April 21, 2023 3:28:38 PM
System ID: CN11461066

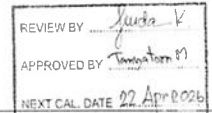
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Certificate of System Qualification

GC-00

System ID: GC-6_CN11461066
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Soi 40 Phatthanakan Rd, Khwaeng Suan Luang, Khai Suan Luang, Bangkok 10250

Date: October 22, 2024 9:27:05 AM
EQP Name: Agilent/Recommended
EQP Revision: GC.02.53
Overall Qualification Status: Pass



CDS Logon Verification - GC

Logon: Saenguthai Larkh

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure: Decay

Name: 7890
Front SSL

Setpoint Status: Pass
Pressure: 25.0 psi
Pressure Change: 0.0 psi / 5 minutes
Agilent Recommended: >= -2.0 and <= 0.5

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front SSL

Setpoint Status: Pass

	Setpoint	Actual
Inlet Pressure:	25.0 psi	25.07 psi
Accuracy:		0.1 psi
Agilent Recommended:	<= 1.2	

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name: 7890
Back SSL

Setpoint Status: Pass

	Pressure	Pressure Change
Pressure:	25.0 psi	0.0 psi / 5 minutes
Agilent Recommended:	>= -2.0 and <= 0.5	

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Back SSLDate: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Setpoint Status:

Pass

	Setpoint	Actual
Inlet Pressure:	25.0 psi	25.06 psi
Accuracy:		0.1 psi
Agilent Recommended:	<= 1.2	

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Front FID

Setpoint Status: Pass

	Flow Type	Setpoint	Measured Flow
Flow Type:	Fuel		
Setpoint:	30.0 mL/min		28.8 mL/min
Accuracy:		1.2 mL/min	
Agilent Recommended:	<= 10.0 % setpoint	(3.0 mL/min)	

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

	Flow Type	Setpoint	Measured Flow
Flow Type:	Oxidizer		
Setpoint:	400.0 mL/min		392 mL/min
Accuracy:		8.0 mL/min	
Agilent Recommended:	<= 10.0 % setpoint	(40.0 mL/min)	

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

	Flow Type	Setpoint	Measured Flow
Flow Type:	Makeup		
Setpoint:	25.0 mL/min		25.4 mL/min
Accuracy:		0.4 mL/min	
Agilent Recommended:	<= 10.0 % setpoint	(2.5 mL/min)	

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Back FID

Setpoint Status: Pass

	Flow Type	Setpoint	Measured Flow
Flow Type:	Fuel		
Setpoint:	30.0 mL/min		30.8 mL/min
Accuracy:		0.8 mL/min	
Agilent Recommended:	<= 10.0 % setpoint	(3.0 mL/min)	

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

	Flow Type	Setpoint	Measured Flow
Flow Type:	Oxidizer		
Setpoint:	400.0 mL/min		393 mL/min
Accuracy:		7.0 mL/min	
Agilent Recommended:	<= 10.0 % setpoint	(40.0 mL/min)	

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

	Flow Type	Setpoint	Measured Flow
Flow Type:	Makeup		
Setpoint:	25.0 mL/min		25.2 mL/min
Accuracy:		0.2 mL/min	
Agilent Recommended:	<= 10.0 % setpoint	(2.5 mL/min)	

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Setpoint Status:

Pass

	Zone	Setpoint/Actual
Temperature:	Oven	230.0 230.3 °C
Accuracy:		0.3 °C
Agilent Recommended:	>= -1.0 °C	(-5.0 °C)
	<= 1.0 °C	(5.0 °C)

Setpoint Status: Pass

	Zone	Setpoint/Actual
Temperature:	Oven	100.0 100.0 °C
Accuracy:		0.0 °C
Agilent Recommended:	>= -1.0 °C	(-3.7 °C)
	<= 1.0 °C	(3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

	Setpoint/Average
Temperature:	100.0 100.0167 °C
Stability:	0.1 °C
Agilent Recommended:	<= 0.5 °C

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1 Front SSL / Front FID

Name: 7693A

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Setpoint Status: **Completed**

Injection Volume on Column: **1.0** μ L

Overall Scouting Run Status: **Completed**

Noise and Drift

Tested Combination1: Front SSL / Front FID

Name: **7890**

Setpoint Status: **Pass**

Base Signal: **14.05** pA

ASTM Noise: **0.05** pA
Agilent Recommended: **<= 0.10**

Drift: **0.03** pA/hr
Agilent Recommended: **<= 2.50**

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1: Front SSL / Front FID

Name: **7893A**

Setpoint Status: **Pass**

Injection Volume on Column: **1.0** μ L

Area RSD: **0.30** %
Agilent Recommended: **<= 3.00**

Retention Time RSD: **0.63** %
Agilent Recommended: **<= 1.00**

Overall Injection Precision Test Status

Pass

Signal to Noise

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Tested Combination1: Front SSL / Front FID

Injection Tower

Name: **7890**

Setpoint Status: **Pass**

Signal to Noise: **11078525**
Agilent Recommended: **>= 300000**

Overall Signal to Noise Test Status

Pass

Scouting Run

Tested Combination2: Back SSL / Back FID

Injection Tower

Name: **7893A**

Setpoint Status: **Completed**

Injection Volume on Column: **1.0** μ L

Overall Scouting Run Status: **Completed**

Noise and Drift

Tested Combination2: Back SSL / Back FID

Name: **7890**

Setpoint Status: **Pass**

Base Signal: **13.79** pA

ASTM Noise: **0.05** pA
Agilent Recommended: **<= 0.10**

Drift: **0.01** pA/hr
Agilent Recommended: **<= 2.50**

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2: Back SSL / Back FID

Name: **7893A**

Setpoint Status: **Pass**

Injection Volume on Column: **1.0** μ L

Area RSD: **1.06** %
Agilent Recommended: **<= 3.00**

Retention Time RSD: **0.93** %
Agilent Recommended: **<= 1.00**

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2: Back SSL / Back FID

Injection Tower

Name: **7890**

Setpoint Status: **Pass**

Signal to Noise: **1771221**
Agilent Recommended: **>= 300000**

Overall Signal to Noise Test Status: **Pass**

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID: GC-6_CN11461066

Manufacturer: Agilent Technologies

Name: 7890

Flow Data Input: Manual Data

Temperature Data Input: Manual Data or Other Data Logging

Tested Combination1

Injection Technique: Injection Tower

Sampler Identifier: Sampler 1

Inlet: Front

Detector: Front

LTM Included?: No

Tested Combination2

Injection Technique: Injection Tower

Sampler Identifier: Sampler 2

Inlet: Back

Detector: Back

LTM Included?: No

Sampler 1

Manufacturer: Agilent Technologies

Type: Injection Tower

Name: 7893A

Model Number: G4513A

Serial Number: CNCN10340103

Firmware Revision: A.11.05

Usage: Sample Injection

Location: Front

Syringe Volume (μ L): 10

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Sampler 2	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7893A
Model Number	G4513A
Serial Number	CN16280128
Firmware Revision	A.11.06
Usage	Sample Injection
Location	Back
Syringe Volume (µL)	10
Sampler 3	
Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN15380030
Firmware Revision	A.11.03
Vali Heater	Not Installed
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461068
Firmware Revision	A.01.16
Oven Type	Standard

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CNI1461068

Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Inlet 2	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen
Detector 2	
Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Back
Makeup Gas	Nitrogen

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CNI1461068

Electronic Signature

Purpose
This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and login to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details	
Full Name of Signer:	Saenguthai Tarak
Logged On User Name:	saenguthai.tarak@non.agilent.com
Signature Creation Date:	October 22, 2024
Reason for Signature:	Executed protocol and published this original version of document

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CNI1461068

User Name: Saenguthai.Tarak Report Generated by Hostname: LAUPTOP-CD15KQWV System ID: GC-6_CNI1461068 Print Date: October 22, 2024 9:27:05 AM				
2024_ALS_GC-6_CNI1461068_OGHW Transaction Log :				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2024 3:16:06 PM	Audit	Session Created	Session	None
October 21, 2024 3:16:07 PM	Start	Configuration	Session	None
October 21, 2024 3:16:37 PM	Audit	Enrollment	Unlocking	User is Nonpaying and does not require an unlock code
October 21, 2024 3:22:45 PM	Audit	Exp.Located	Session	EOP details for primary technique [GC] - File path: [Protocol]Pads\GC\Config\Inst02.G3G\02.G3.exp] EOP File Name: [GC-02.G3.exp] EOP Name: [AgilentRecommended]Protocol Revision [GC-02.G3]
October 21, 2024 3:22:46 PM	End	Configuration	Session	None
October 21, 2024 3:22:47 PM	Start	Qualification	Session	OQ
October 21, 2024 3:22:48 PM	Start	Execution	GC5 Logon Verification - GC-7890 - Qualitative test	None
October 21, 2024 3:23:36 PM	End	Execution	GC5 Logon Verification - GC-7890 - Qualitative test	Run Count: 1
October 21, 2024 3:23:45 PM	Start	Execution	System Inspection and Back Safety and Operation - 7890 - Qualitative Test - No setpoints associated	None
October 21, 2024 3:23:58 PM	End	Execution	System Inspection and Back Safety and Operation - 7890 - Qualitative Test - No setpoints associated	Run Count: 1

Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CNI1461068

User Name: sangeetha.tarak
Report Generated by Hostname: LAPTOP-CQ3SK0MV
System ID: GC-6_CN11461066
Print Date: October 22, 2024 9:27:36 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2024 3:24:01 PM	Start	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None
October 21, 2024 3:25:26 PM	End	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count: 1
October 21, 2024 3:25:28 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
October 21, 2024 3:25:32 PM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
October 21, 2024 3:25:50 PM	Start	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None
October 21, 2024 3:26:01 PM	End	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count: 1
October 21, 2024 3:26:05 PM	Start	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
October 21, 2024 3:26:10 PM	End	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
October 21, 2024 3:26:12 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None

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User Name: sangeetha.tarak
Report Generated by Hostname: LAPTOP-CQ3SK0MV
System ID: GC-6_CN11461066
Print Date: October 22, 2024 9:27:04 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2024 3:26:50 PM	Audit	Data	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 21, 2024 3:26:53 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
October 21, 2024 3:26:54 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 21, 2024 3:27:10 PM	Audit	Data	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 21, 2024 3:27:13 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
October 21, 2024 3:29:11 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 21, 2024 3:29:27 PM	Audit	Data	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 21, 2024 3:29:29 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
October 21, 2024 3:29:30 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
October 21, 2024 3:29:47 PM	Audit	Data	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 21, 2024 3:29:52 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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User Name: sangeetha.tarak
Report Generated by Hostname: LAPTOP-CQ3SK0MV
System ID: GC-6_CN11461066
Print Date: October 22, 2024 9:27:55 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2024 3:29:54 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 21, 2024 3:30:07 PM	Audit	Data	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 21, 2024 3:30:09 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
October 21, 2024 3:30:11 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 21, 2024 3:30:34 PM	Audit	Data	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 21, 2024 3:30:37 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
October 21, 2024 3:30:38 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
October 21, 2024 3:31:55 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 21, 2024 3:31:57 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1

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User Name: sangeetha.tarak
Report Generated by Hostname: LAPTOP-CQ3SK0MV
System ID: GC-6_CN11461066
Print Date: October 22, 2024 9:27:56 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2024 3:31:59 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 130.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
October 21, 2024 3:34:37 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 130.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 21, 2024 3:34:39 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 130.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
October 21, 2024 3:34:42 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
October 21, 2024 3:39:55 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
October 21, 2024 3:39:57 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
October 21, 2024 3:39:59 PM	Start	Execution	GC Solvent Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 21, 2024 3:40:12 PM	Audit	AcqClosed	Session	None
October 22, 2024 8:55:47 AM	Audit	AcqResumed	Session	None
October 22, 2024 8:55:50 AM	Audit	SessionRetraced	Session	None
October 22, 2024 8:56:02 AM	Start	Qualification	Session	OQ

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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User Name: seenguthai.larak
Report Generated by Hostname: LAPTOP-CQ3BKDMV
System Id: GC-6_CN11461066
Print Date: October 22, 2024 9:27:06 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 22, 2024 8:56:02 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 22, 2024 8:56:46 AM	Audit	Data	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Data file Path : G:\Data\Front\Front_ISC10.D\FID1A.ch
October 22, 2024 8:57:25 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Run Count: 1
October 22, 2024 8:57:39 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	None
October 22, 2024 8:58:03 AM	Audit	Data	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data file Path : G:\Data\Front\Front_NO10.D\FID1A.ch
October 22, 2024 8:58:37 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count: 1
October 22, 2024 8:58:40 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	None
October 22, 2024 8:59:06 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data Manager was in a data verification state but the user chose to start over

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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User Name: seenguthai.larak
Report Generated by Hostname: LAPTOP-CQ3BKDMV
System Id: GC-6_CN11461066
Print Date: October 22, 2024 9:27:06 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 22, 2024 9:01:43 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Front\Front_IP0105.D\FID1A.ch
October 22, 2024 9:01:43 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Front\Front_IP0106.D\FID1A.ch
October 22, 2024 9:01:43 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Front\Front_IP0107.D\FID1A.ch
October 22, 2024 9:01:43 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Front\Front_IP0108.D\FID1A.ch
October 22, 2024 9:01:43 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Front\Front_IP0109.D\FID1A.ch
October 22, 2024 9:01:43 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Front\Front_IP0110.D\FID1A.ch
October 22, 2024 9:02:11 AM	End	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Run Count: 1
October 22, 2024 9:02:16 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	None
October 22, 2024 9:02:34 AM	Audit	Data	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	Data file Path : G:\Data\Front\Front_SNO1A.D\FID1A.ch

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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User Name: seenguthai.larak
Report Generated by Hostname: LAPTOP-CQ3BKDMV
System Id: GC-6_CN11461066
Print Date: October 22, 2024 9:27:05 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 22, 2024 9:02:54 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	Run Count: 1
October 22, 2024 9:03:00 AM	Start	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	None
October 22, 2024 9:03:31 AM	Audit	Data	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Data file Path : G:\Data\Back\Back_ISC01.D\FID2B.ch
October 22, 2024 9:04:03 AM	End	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Run Count: 1
October 22, 2024 9:04:06 AM	Start	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	None
October 22, 2024 9:04:30 AM	Audit	Data	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data file Path : G:\Data\Back\Back_NO01.D\FID2B.ch
October 22, 2024 9:04:13 AM	End	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count: 1
October 22, 2024 9:04:36 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	None

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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User Name: seenguthai.larak
Report Generated by Hostname: LAPTOP-CQ3BKDMV
System Id: GC-6_CN11461066
Print Date: October 22, 2024 9:27:06 AM

2024_ALS_GC-6_CN11461066_OQHW Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 22, 2024 9:10:44 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Back\Back_IP0111.D\FID2B.ch
October 22, 2024 9:10:44 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Back\Back_IP0112.D\FID2B.ch
October 22, 2024 9:10:44 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Back\Back_IP0113.D\FID2B.ch
October 22, 2024 9:10:44 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Back\Back_IP0114.D\FID2B.ch
October 22, 2024 9:10:44 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Back\Back_IP0115.D\FID2B.ch
October 22, 2024 9:10:44 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Data file Path : G:\Data\Back\Back_IP0116.D\FID2B.ch
October 22, 2024 9:11:19 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Rel. Time) <= 1.00%	Run Count: 1
October 22, 2024 9:11:23 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	None
October 22, 2024 9:11:45 AM	Audit	Data	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	Data file Path : G:\Data\Back\Back_SNO1A.D\FID2B.ch

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Date: October 22, 2024 9:27:05 AM
System ID: GC-6_CN11461066

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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

Wind tunnel cross-section area¹Win direction frontal area²Diameter of mounting plate³Blockage ratio of test object⁴

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

1. Mr. Sarwan Thairasakul

2. Miss Jiraporn Lertsomphol

Remarks:

1. Inside cross-section area of the wind tunnel

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

3. Diameter of mounting plate

4. Ratio: 10%

Cup anemometer

Navalyn

Sensor: WS-02F

Data logger: 200-WS-250L

Sensor: WSD-4495S

Data logger: 4495S

RVD-F5008S

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phuthunanan Rd., Maechanaburi Rd., Khwaeng Suan Luang,

Kiet Suan Luang, Bangkok 10250 Thailand

16 Jun 2023

19 Jun 2023

19 Jun 2023

23.0 ± 3.0 °C

55.0 ± 15.0 %RH

1010 ± 10 hPa

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

Wind tunnel cross-section area¹Win direction frontal area²Diameter of mounting plate³Blockage ratio of test object⁴

24 hours at ambient conditions

The average values during measurement are (25.0)°C, (42.7) %RH and (1011.7) hPa.

The table on next page give the measured values.

Calibrated by:

1. Mr. Sarwan Thairasakul

2. Miss Jiraporn Lertsomphol

Remarks:

1. Inside cross-section area of the wind tunnel

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

3. Diameter of mounting plate

4. Ratio: 10%

Calibration procedure:

The cup anemometer was calibrated against

Standard air velocity transducer (model: 4475-22

and pitot tube with precision differential pressure

meter model: DPM1500 in an open test-section of

Effel-type wind tunnel with 900 cm² cross test

section area. The W-01.007 based on: IEC 61400-12-1,

Wind energy generation systems - Part 12-1

Power performance measurements of

electricity producing wind turbines, March 2017

was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the

measurement to recognized the national

standards and to realization of the international

system of units (SI) through the NIMT (National

Metrology Institute of Thailand) via Certificate

number: NM-0050-21 and NM-0056-22

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"

Traceability:

This certificate provides a traceability of the

measurement to recognized the national

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("Evaluation of measurement

data - Guide to the expression of uncertainty in

measurement"

Traceability:

Certificate Number
CO-008-65

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MEASUREMENT RESULTS⁵

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 ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	45.000	44	-1	1.0
	90.001	87	-3	1.0
	135.000	132	-3	1.0
	180.000	179	-1	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	319	4	1.0
	360.000	359	-1	1.0

Remark:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

⁶ Direction of standard

⁷ Direction of Unit Under Calibration

End of Certificate of Calibration



J NAC
JIRARATTEE ASSOCIATES CO., LTD.

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Bangkok 10230 (Thailand)
Tel: +66 (0) 2 614 0000
Mobile: +66 (0) 9 099 8853
E-mail: jnac@jirarattee.com
Web site: www.jirarattee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TS1-TS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

REVIEWED BY: *Mr. Panya Booncharoen*
APPROVED BY: *Mr. Panya Booncharoen*
EFFECTIVE DATE: 30/12/19

Certificate Number
CC-015-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

Novallix

Sensor: WS-02FA

Data logger: 110-WS-2500-D

Sensor: WSD-A5580

Data logger: ASS80

RYG_F50649

New item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

16 Jun 2023

20 Jun 2023

20 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹

900 cm²

Win direction frontal area²

100 cm²

Diameter of mounting pipe³

mm

Blockage ratio of test object⁴

0.111 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (24.4) °C, (41.8) %RH and (1011.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Sorawit Thachulad

Miss Jiraporn Lertsichaihol



Approved signatory

Mr. Panya Booncharoen
Calibration Department Manager

Remark:

¹ Nozzle 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 (%)

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

Certificate Number
CC-015-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both ranging and flying air velocity in the range of 3 m/s to 18 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 (k=2) (m/s)
1.023	24.30	24.40	0.9	-0.1	0.31
2.025	24.50	24.40	1.9	-0.1	0.31
2.956	24.40	24.40	2.9	-0.1	0.31
4.169	24.84	24.40	4.0	-0.1	0.31
5.03	24.32	24.40	4.9	-0.1	0.31
6.01	24.32	24.40	5.9	-0.2	0.31
7.05	24.24	24.40	7.0	-0.1	0.31
8.27	24.14	24.40	8.0	-0.7	0.31
9.10	24.20	24.40	9.0	-0.1	0.31
10.08	24.10	24.40	9.9	-0.1	0.31
11.14	24.20	24.40	11.0	-0.1	0.31
12.13	24.10	24.40	12.0	-0.2	0.31
13.19	24.14	24.40	13.0	-0.2	0.31
14.23	24.10	24.40	14.0	-0.2	0.31
15.33	24.10	24.40	15.0	-0.2	0.31
16.29	24.10	24.40	16.1	-0.2	0.32

Remark:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jirarattee Associates Co., Ltd. The cup anemometer shown may differ from the calibration one. Remark: The proportion of the set up is not shown here and is not for reference.



J NAC
JIRARATTEE ASSOCIATES CO., LTD.

Jirarattee Associates Co., Ltd.
CP114 15, CP135 35
Ponprasam 2324, Ari-Adm Building, Bangkok,
Bangkok 10230 (Thailand)
Tel: +66 (0) 2 614 0000
Mobile: +66 (0) 9 099 8853
E-mail: jnac@jirarattee.com
Web site: www.jirarattee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TS1-TS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number
CC-015-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novallix

Sensor: WS-02FA

Data logger: 110-WS-2500-D

Sensor: WSD-A5580

Data logger: ASS80

RYG_F50649

New item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

16 Jun 2023

20 Jun 2023

20 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹

900 cm²

Win direction frontal area²

129 cm²

Diameter of mounting pipe³

mm

Blockage ratio of test object⁴

0.143 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (24.3) °C, (47.4) %RH and (1010.9) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Sorawit Thachulad

Miss Jiraporn Lertsichaihol



Approved signatory

Mr. Panya Booncharoen
Calibration Department Manager

Remark:

¹ Nozzle 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 (%)

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

MEASUREMENT RESULTS⁵

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 ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.6
	45.000	43	-2	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
5.02	180.000	180	0	1.0
	225.000	226	1	1.0
	270.000	272	2	1.0
	315.000	318	3	1.0

Remark:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

⁶ Direction of standard

⁷ Direction of Unit Under Calibration

End of Certificate of Calibration



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



CERTIFICATE OF CALIBRATION

Certificate No.: CT-025-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novatynx
Model: 110-WS-250L-D
Serial No.: A5980
ID No.: RYG_FS0649

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

Received date: 16 Jun 2023
Calibration date: 20 Jun 2023
Issue date: 22 Jun 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-1000-A 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. Parnya Booncharoen
Calibration Department Manager

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



Certificate No.: CT-025-66
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

Function:

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



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

CERTIFICATE OF CALIBRATION

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

Measurement Item : Relative humidity with data logger
Manufacturer : Novatynx
Model/Type : 110-WS-250L-D
Serial Number : A5980
ID No. : RYG_FS0649
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±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 186D-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) via MCS Calibration, Inc. Certificate number 20926-001, Due date: Sep 26, 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 (reading) (%RH)	UUC (reading) (%RH)	Diff. (%RH)	Uncertainty ±(%RH)
20	20.04	19.3	-0.7	0.62
50	50.26	49.5	-0.8	0.62
80	80.33	80.5	0.2	0.62

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



Approved Signatory:
Mr. Parnya 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 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

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

SERIAL NUMBER

Sensor: BPA5580
Data logger: AS580
RYG_F30545

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

New item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Phatthanakan Rd.,
Khaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

RECEIVED DATE

16 Jun 2023

MEASUREMENT DATE

20 Jun 2023

ISSUE DATE

20 Jun 2023

Calibration procedure:

The pressure calibration was done by in-house calibration method as V0-CL-003 according to comparison method with Digital pressure calibrator based on GUM 2.1.

Traceability:

The measurement results are traceable to the International System of Units (SI) through the NMIT (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	4100176P	MP-0205-22	02 Dec 2023

2. Calibration effort for calibration sequence C

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

4. Calibration conditions:

4. Condition
Pressure transmitting medium : Air
 p_h (20°C, 1 bar) : 1.18 kg/m³
 H_{max} : (55±15) %
 t_{avg} : (23±1) °C
 p_{max} : (1010±10) mbar

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

Calibrated by:
Mr. Sorawit Thuchalad
Miss Jiraporn Lertsomphol



Approved signatory
Mr. Perinya Booncharoon
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)
950.11	950.5	0.6	0.84
970.04	970.4	0.4	0.60
990.10	990.3	0.2	0.46
1010.05	1010.1	0.0	0.37
1030.10	1029.6	-0.3	0.50
1050.08	1049.5	-0.5	0.75

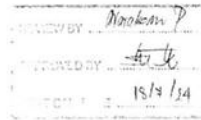
Note: UUC* Unit Under Calibration

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

End of certificate



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



Certificate Number

CL-009-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The anemometer velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 10 mm and 350 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v_{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
0.981	23.56	23.45	0.8	-0.2	0.15
2.030	23.60	23.45	1.9	-0.2	0.16
3.049	23.50	23.45	2.9	-0.2	0.17
4.129	23.50	23.45	3.9	-0.3	0.20
5.01	23.50	23.45	4.8	-0.2	0.17
5.97	23.54	23.45	5.7	-0.3	0.17
7.05	23.62	23.45	6.8	-0.3	0.18
8.18	23.50	23.45	7.8	-0.3	0.19
9.10	23.45	23.45	8.8	-0.3	0.19
10.10	23.40	23.45	9.7	-0.4	0.19
11.14	23.40	23.45	10.8	-0.4	0.20
12.13	23.32	23.45	11.8	-0.4	0.20
12.20	23.10	23.45	12.9	-0.3	0.20
14.25	23.36	23.45	13.9	-0.4	0.22
15.24	23.22	23.45	14.8	-0.4	0.21
15.30	23.40	23.45	15.6	-0.5	0.22

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

End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Cup anemometer

MANUFACTURER

Novolyne

MODEL/TYPE

Sensor: WS-E2E

SERIAL NUMBER

Data logger: 110-WS-16N

ID NUMBER

Sensor: -

CONDITION AS-RECEIVED

CUSTOMER

Data logger: 1159
RYG_F30583
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Phatthanakan Rd., Khaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

16 Jun 2023

MEASUREMENT DATE

18 Jan 2023

ISSUE DATE

20 Jan 2023

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 : 1010 ± 10 hPa

PLACE OF CALIBRATION

1. Ell-type wind tunnel of Jirananth Associates Co., Ltd.

CALIBRATION CONDITIONS

(Wind tunnel cross-section area)¹ : 900 cm²
Win direction frontal area² : 100 cm²
Diameter of mounting pipe³ : - mm
Blockage ratio of test object⁴ : 0.111 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.5) °C, (52.2) %RH and (1014.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
Mr. Sorawit Thuchalad
Miss Jiraporn Lertsomphol

Approved signatory
Mr. Perinya Booncharoon
Calibration Department Manager

Footnote:
¹ Measured 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 $\frac{A_{obj}}{A_{tunnel}}$

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

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 production of the set-up is not true to scale due to missing equipment.

Certificate Number
CWD-003-66

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor
Navalyns
Sensor: WS-02F
Data logger: 200-WS-25LB
Sensor: WSD-AS100
Data logger: AS190
RYE_F50329
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phranthakan 40, Phranthakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder mark AA400975. DMS4-PS-5.00 in on-site test section of E-type wind tunnel with 900 cm² cross test section area. The WDC-003 based on IEC 62430-12-2. Wind energy generation system - Part 12-2. Power performance measurement of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

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

Uncertainty of Measurement:

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

11 Aug 2023

18 Aug 2023

21 Aug 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

E-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 129 cm²
Diameter of mounting pipe³ - mm
Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (23.9) °C, (44.8) %RH and (1009.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thirachai
☐ Miss Jiraporn Tontaporn



Approved signature:

Mr. Pannas Booncharoen
Calibration Department Manager

Remarks:

¹ Actual cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio "a/b"

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

Certificate Number

CWD-003-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed	D _{stat}	D _{lim}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.00	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
	180.000	178	-2	1.0
	225.000	226	1	1.0
	270.000	272	2	1.0
360.000	315.000	319	4	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

End of Certificate of Calibration



Certificate Number
CWS-025-67

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup Anemometer
Navalyns
Sensor: WS-02F
Data logger: 200-WS-25LB-D
Sensor: WSD-AS100
Data logger: AS190
RYE_F50608
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phranthakan 40, Phranthakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:

The Cup anemometer was calibrated against Standard air velocity transducer mark W-15-02 and pilot tube with precision differential pressure meter model DPM2500 in on-site test-section of E-type wind tunnel with 900 cm² cross test section area. The WDC-003 based on IEC 61400-12-2. Wind energy generation system - Part 12-2. Power performance measurement of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

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

Uncertainty of Measurement:

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

18 Jul 2024

18 Jul 2024

18 Jul 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

1010 ± 10 hPa

PLACE OF CALIBRATION

E-type wind tunnel of Jirantee 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 (24.5) °C, (43.4) %RH and (1006.7) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thirachai
☐ Miss Jiraporn Tontaporn



Approved signature:

Mr. Pannas Booncharoen
Calibration Department Manager

Remarks:

¹ Actual cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio "a/b"

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

Certificate Number

CWS-025-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 30 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 15 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel centre and installed 40 mm away from tip of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pilot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from tip of the test section. UUC was mounted on a round vertical base of 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 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

UUC	Temp. wind tunnel	Temp. room	UUC	Error	U (k=2)
(m/s)	(°C)	(°C)	(m/s)	(m/s)	(m/s)
0.997	24.28	24.45	0.8	-0.3	0.11
2.014	24.20	24.45	1.8	0.2	0.11
2.930	24.83	24.45	2.9	0.1	0.11
4.102	24.80	24.45	3.8	0.3	0.11
4.97	24.89	24.45	5.0	0.0	0.11
5.18	24.50	24.45	6.0	0.0	0.11
7.03	24.70	24.45	7.1	0.1	0.11
7.95	24.38	24.45	8.1	0.1	0.11
9.04	24.70	24.45	9.1	0.1	0.11
9.18	24.36	24.45	10.2	0.2	0.11
10.99	24.60	24.45	11.2	0.2	0.11
12.03	24.40	24.45	12.2	0.2	0.11
12.97	24.70	24.45	13.2	0.2	0.11
14.10	24.50	24.45	14.3	0.2	0.11
15.03	24.70	24.45	15.2	0.2	0.11
15.99	24.68	24.45	16.2	0.2	0.11

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 Jirantee 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.



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	D ₁₀₀	D ₁₀₀	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	0.000	0	0	0.80
	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	178	-2	0.80
	225.000	225	0	0.80
	270.000	272	2	0.80
	315.000	319	4	0.80

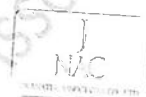
Remark:

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Wind Direction Sensor
: Novamir
: Sensor: WS-02F

SERIAL NUMBER

Data logger: 110-WS-25DL-D
: Sensor: WS-02F
Data logger: AS500

ID NUMBER

: RYG-F5060B

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 Jul 2024

MEASUREMENT DATE

: 18 Jul 2024

ISSUE DATE

: 18 Jul 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: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹: 900 cm²

Wind direction horizontal area²: 129 cm²

Diameter of mounting pipe³: 1 mm

Blockage ratio of test object⁴: 0.143 (-)

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (22.4)°C, (43.3) %RH and (1004.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thuechad
☒ Miss Jitraporn Terisomchai
☒ Miss Jiraporn Terisomchai



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Actual cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio (%)

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 °C to 40 °C

Functions:

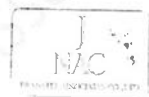
Table 3: This equipment was connected with temperature sensor Model: HM160 S/N: U3641220,
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth	Standard Reading	UUC Reading	Error	Uncertainty
(mm)	(°C)	(°C)	(°C)	(°C)
80	20.047	19.8	-0.2	0.099
80	25.043	24.8	-0.2	0.099
80	30.034	29.8	-0.2	0.099
80	35.028	34.8	-0.2	0.099
80	40.016	39.7	-0.3	0.16

UUC¹: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.16 based on standard uncertainty multiplied by a coverage factor k=2.23 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-120-67

Page 1 of 2 Pages

MEASUREMENT ITEM

: Data Logger with Temperature sensor

MANUFACTURER

: Novamir

MODEL/TYPE

: 110-WS-25DL-D

SERIAL NUMBER

: AS500

ID NUMBER

: RYG-F5060B

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 Jul 2024

MEASUREMENT DATE

: 18 Jul 2024

ISSUE DATE

: 18 Jul 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

NOTE: 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 per CL-001
according to comparison method with standard
digital temperature indicator and standard
temperature probe. The temperature scale was
was based on ITS-90.

Traceability:

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

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 047682-09,
Due date: 26 Mar 2025
2. Digital Temperature Indicator
Model: DT11000-A-M, Serial No.: 671407-
00591 Due date: 18 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. The evaluation of measurement data
guide to the expression of uncertainty in
measurement.

Calibrated by:

☒ Mr. Sorawit Thuechad
☒ Miss Jitraporn Terisomchai
☒ Miss Jiraporn Terisomchai



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No.: CRT-022-67

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Relative humidity with data logger

Model: 110-WS-2501-D

Sensor: HMF60

Date Logger: AS909

Sensor: U2941220

IRV: 750008

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanasarak 40, Phatthanasarak Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

Received Date: 08 Jul 2024

Measurement Date: 18 Jul 2024

Issue Date: 19 Jul 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Calibration procedure:
The Relative humidity and Air Temperature calibration was done by in-house calibration method as per CL 009 and WH 1.010 according to comparison method with Standard. Chilled Meter Hygrometer with Temperature sensor and standard humidity generator chamber.

Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: Tn0079-23 and through Jiranan Associates Co., Ltd. Certificate number: CRT 001 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.

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.

Calibrated by:
☐ Mr. Jiranan Thachalad
☐ Mr. Jiranan Lertsomphol
☐ Mr. Runggrat Poommit



Approved signature

Mr. Panyak Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number: CRT-022-67

Page 2 of 2 Pages

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)
29.79	19.49	17.5	-1.99	0.91
29.82	50.54	47.3	-3.2	1.3
29.81	81.68	77.1	-4.6	2.3

UUC: Unit Under Calibration

End of Certificate of Calibration



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



NSC-TISI-TIS 17025
CALIBRATION 0367

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 35° intervals in clockwise and counter-clockwise directions after official adjustment has been made. The flow speed of wind tunnel (initially 5 m/s) is kept constant while the sensor is located 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 _{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.0	45.000	43	-2	0.80
	50.000	47	-3	0.80
	135.000	132	-3	0.80
	180.000	179	-1	0.80
	225.000	226	1	0.80
	270.000	271	1	0.80
	315.000	318	3	0.80
	360.000	359	-1	0.80

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.

End of Certificate of Calibration



MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novallym

Sensor: WS-02F

Data logger: 200-WS-25LR

Sensor: WS1-A4903

Data logger: A4903

SKK-F50159

Used item

AIS laboratory group (Thailand) Co., Ltd.

101 Phatthaburan 40, Phatthaburan Rd., Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

17 May 2024

21 May 2024

21 May 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: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹

900

cm²

Wind direction frontal area²

129

cm²

Diameter of mounting pipe³

1

mm

Backsight ratio of test object⁴

0.143

[-]

Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (23.3) °C, (43.3) %RH and (1003.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thumthais

Mr. Jiraporn Jirapornrat



Approved signature:

Mr. Panyee Jirapornrat
Calibration Department Manager

Remarks:

¹ Wind tunnel cross-section area of the wind tunnel.

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

³ Diameter of mounting pipe.

⁴ Ratio [-].

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

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer 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 mini tube wall precision differential pressure meter 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 round vertical tube of 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 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 _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
1.015	23.50	23.80	0.8	-0.2	0.31
2.041	24.26	23.50	1.6	-0.2	0.31
3.007	23.30	23.50	2.9	-0.1	0.31
4.108	23.34	23.50	3.8	-0.3	0.31
4.38	23.36	23.50	5.0	0.0	0.31
5.35	23.50	23.90	6.0	0.3	0.31
7.02	23.14	23.90	7.1	0.1	0.31
7.96	23.30	23.90	8.0	0.1	0.31
8.18	23.26	23.90	9.1	0.3	0.31
9.56	23.16	23.90	10.1	0.1	0.31
10.93	23.50	23.90	11.1	0.1	0.31
12.02	23.30	23.90	12.2	0.1	0.31
12.94	23.50	23.90	13.2	0.2	0.31
14.08	23.38	23.90	14.2	0.1	0.31
15.02	23.60	23.90	15.2	0.2	0.31
15.93	23.50	23.90	16.0	0.3	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 setup of the Cup anemometer calibration in the wind tunnel of Hiranatee Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of this set-up is not true to scale due to imaging geometry.

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

Novallym

Sensor: WS-02F

Data logger: WS-25DL

Sensor: WS0-A4481

Data logger: A4481

SKK-F50141

Used item

AIS laboratory group (Thailand) Co., Ltd.

101 Phatthaburan 40, Phatthaburan Rd., Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

08 Aug 2024

20 Aug 2024

20 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: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹

500

cm²

Wind direction frontal area²

100

cm²

Diameter of mounting pipe³

1

mm

Backsight ratio of test object⁴

0.111

[-]

Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (23.0) °C, (42.7) %RH and (1005.0) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thumthais

Mr. Jiraporn Jirapornrat



Approved signature:

Mr. Panyee Jirapornrat
Calibration Department Manager

Remarks:

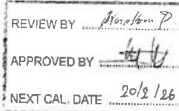
¹ Wind tunnel cross-section area of the wind tunnel.

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

³ Diameter of mounting pipe.

⁴ Ratio [-].

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



MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and 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	D _{rot}	D _{enc}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
45.000	41	-4	-0.80	0.80
90.000	67	-3	-0.80	0.80
135.000	134	-1	-0.80	0.80
180.000	182	2	-0.80	0.80
225.000	230	5	-0.80	0.80
270.000	275	5	-0.80	0.80
315.000	320	5	-0.80	0.80
360.000	359	-1	-0.80	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 Unit Under Calibration.

End of Certificate of Calibration



MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor
Navalyns
Sensor WS-027

SERIAL NUMBER

Data logger: WS-250L
Sensor: WSD-A4482

ID NUMBER

Data logger: A4482

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: 1010 ± 10 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 1 mm
Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.7) °C, (45.7) %RH and (1007.7) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thorphad
☐ Miss Jittrapee Jantamphol



Approved signatory

Mr. Panyas Booncharoen
Calibration Department Manager

Remarks:

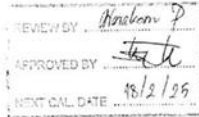
¹ Inside cross-section area of the wind tunnel

² Projected frontal area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio: [-]

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



MEASUREMENT RESULTS¹

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

V _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
1.032	24.10	24.30	0.9	-0.1	0.31
2.065	24.54	24.30	1.9	-0.2	0.31
3.098	24.06	24.30	2.9	-0.1	0.31
4.220	24.04	24.30	4.0	-0.2	0.33
5.00	23.78	24.30	4.9	-0.1	0.31
5.97	23.82	24.30	5.9	-0.1	0.31
7.01	23.78	24.30	6.9	-0.1	0.31
8.13	24.00	24.30	8.0	-0.1	0.31
9.07	23.82	24.30	9.0	-0.1	0.31
10.07	23.80	24.30	9.9	-0.1	0.31
11.13	23.84	24.30	11.1	0.0	0.31
12.13	23.80	24.30	12.0	-0.1	0.31
13.19	23.82	24.30	13.2	0.0	0.31
14.24	23.74	24.30	14.3	-0.1	0.31
15.20	23.80	24.30	15.2	0.0	0.33
16.26	23.74	24.30	16.1	-0.2	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 Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



Calibration setup of the cup anemometer calibration is 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 due to scale due to imaging accuracy.



MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Cup anemometer
Navalyns
Sensor WS-027

SERIAL NUMBER

Data logger: 200 WS 25LB
Sensor: WSD-AS190

ID NUMBER

Data logger: AS190

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 Aug 2023

MEASUREMENT DATE

18 Aug 2023

ISSUE DATE

21 Aug 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION

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 1 mm
Blockage ratio of test object⁴ 0.111 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (24.3) °C, (43.3) %RH and (1005.59) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thorphad
☐ Miss Jittrapee Jantamphol



Approved signatory

Mr. Panyas Booncharoen
Calibration Department Manager

Remarks:

¹ Inside cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio: [-]

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

Page 2 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor
Navalyna
Sensor: WS-02F

SERIAL NUMBER

Data logger: 200-WS-2516

ID NUMBER

Sensor: WS-02F

CONDITION AS-RECEIVED

Data logger: AS190

CUSTOMER

RYG-F50320

RECEIVED DATE

11 Aug 2023

MEASUREMENT DATE

18 Aug 2023

ISSUE DATE

21 Aug 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 0.5 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 128 cm²
Diameter of mounting pipe³ : 4 mm
Blockage ratio of test object⁴ : 0.143 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.9)°C, (44.8) %RH and (1009.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Panyas Boonchuan
Calibration Department Manager

Remarks:

¹ Visible cross-section area of the wind tunnel
² Projected cross-section area of the test object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio $\frac{A_2}{A_1}$

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder mark AN400/15-DN400-PS-5.00 in on cross-section area of Effel-type wind tunnel with 900 cm² cross-section area. The WH-CL-003 based on IEC 63400-12-3, Wind energy generation systems - Part 12-3: Power performance measurement of electricity producing wind turbines, March 2017 was used as a calibration reference.

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: DA-0043-22

Uncertainty of Measurement:

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

MEASUREMENT RESULTS⁵

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 _{ref} Degree (°)	D _{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
45.000	41	41	-4	1.0
90.000	87	87	-3	1.0
135.001	132	132	-3	1.0
180.000	178	178	-2	1.0
225.000	226	226	-1	1.0
270.000	272	272	2	1.0
315.000	319	319	4	1.0
360.000	359	359	-1	1.0

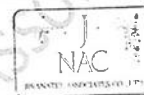
Remark:

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

⁶ Direction of standard

⁷ Direction of Unit Under Calibration

End of Certificate of Calibration



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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL, BP. 83/0267

CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthakan Rd., Phatthakan Rd., Klongwaeng Phatthakan, Khet Suan Luang, Bangkok, 10250.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri IC, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator : Temperature : (23 ± 3) °C
Manufacturer : Rion : Relative Humidity : (50 ± 15) %
Model : NC-74 : Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 34178121 (ID: RYG_F50213)
Standards used : 1. Digital Function Synthesizer NF Electronic DT-193A S/N 122037,
2. Measuring Amplifier Briel&Kjaer 2636 S/N 1537484,
3. Programmable Attenuator Tama-gawa TPA-303A S/N OF 2214,
4. Digital Multimeter Agilent 34401A S/N MY44005560,
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001,
6. Audio Analyzer Keithley 2015-P S/N4106495,
7. Condenser Microphone B&K 4180 S/N 289871.

Calibration Procedure: CIP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at 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.

Date of Receipt : 19 Feb. 2024
Date of Calibration : 28 Feb. 2024

The results are valid only for the items tested in stated or usual condition.
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FORM/MTC-002 Rev.5

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL, BP. 83/0267

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%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Briel&Kjaer 4180	94.01	0.01	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Briel&Kjaer 4180	1003.1	3.1	± 1.5	± 1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Briel&Kjaer 4180	1.80	± 0.50	± 3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from manual.

Calibrated by :

(Mr. Weerachai) (Deechaiyae)

Approved by :

(Mr. Weerachai) (Deechaiyae)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Feb. 2024
Date of Issue : 29 Feb. 2024

Ref: 2011267021900719001

End of Certificate

2 / 2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

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,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A-Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00900073 (ID: RYG_FS0494)

Microphone : UC-52 No.188466

Preamplifier : NII-24 No.01735

Standards used :

1. Band Pass Filter Wavetek 752A S/N 99010494,
2. Condenser Microphone Brüel&Kjær 4180 S/N 2839871,
3. Decade Attenuator Ando AI-205 S/N 00464602,
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY4042668,
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 120377,
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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The results relate only to the items tested and calibrated as presented.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

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 Tanagawa TPA-303A S/N 2212,

Calibration Procedure :

This instrument was calibrated by using calibration procedures on 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, 178/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
	Before adjust	After adjust				
113.91	114.1	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 124.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ 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 ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
A-Weight	12.9	0.10	N/A
C-Weight	18.5	0.10	N/A
Flat	24.2	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, 178/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ 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	-0.7	-0.7	-0.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
	A-weight	C-weight	Flat			
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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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

5. Long-term stability

Time	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	(±dB)	(±dB)	(±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	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	(±dB)	(±dB)	(±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	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	(±dB)	(±dB)	(±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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The results relate only to the items tested and are not valid for other items.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

7. Level linearity on the reference level range

Anticipated value	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
(dB)	(dB)	(dB)	(±dB)	(±dB)	(±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	79.0	0.0	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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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

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

Anticipated value	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
(dB)	(dB)	(dB)	(±dB)	(±dB)	(±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	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	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(dB)	(dB)	(dB)	(±dB)	(±dB)	(±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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The results relate only to the items tested and are not valid for other items.

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FM/BL/MTC.002 Rev.4

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Fax. (66) 0 21 5192
E-mail: sumalee@tistr.go.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL, BP, 178/0167

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

9. Tone burst response

Time Weighting	Toneburst Duration, 1b	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted uncertainty of measurement
	(ms)	(dB)	(dB)	(±dB)	(±dB)	(±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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The results relate only to the items tested and are not valid for other items.

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FM/BL/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, 178/0167

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	125.3	-0.1	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 :

Approved by :

(Mr. Tawakul Jamsamran)

(Mr. Pravee Klauyap)

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 : 2011267012400347008

End of Certificate

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The results shown only to the extent that the instrument is used as intended. Any other use of the instrument is at the user's risk. The results shown are not to be used for any other purpose without the written permission of TISTR.

FM/EE-MTC-002 Rev.4

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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: 0-2217-3000-24 FAX: 0-2719-9484



Certificate of Calibration

Certificate No. : 23E3924
Page : 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No. : B834291445
ID No. : RYG_EN0152
Condition As-Received : Used Item

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

Received Date : 08 December 2023
Calibration Date : 14 December 2023

Reference : 2312-0151DSC
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 10) %

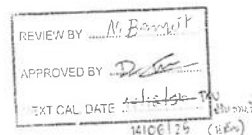
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd., Rayong Branch
616/10 Moo 5, T. Maenam Khu, A. Phakdaeng,
Rayong 21140, Thailand

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	5502A	2435002	EE-0041-23	26 Apr 2024
2. This result of calibration was made on request at the point specified by customer				
3. This 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:- - National Institute of Metrology Thailand (NIMT)				



Calibrated by : Nopachanok Prasomsomrit
Issue Date : 15 December 2023

Approved Signatory :
[] Phalinee Pratapapal
[x] Nuntawat Khemchai
[] Pongsagorn Boonysaporn

1: 0331106



Cert. No.: 23E3924
Page.: 2 of 2

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

Function: DC voltage measurement

Range: 2000 mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (± μV)
-200.0000	-199.9	0.1	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	56
50.0000	50.0	0.0	61
100.0000	100.0	0.0	63
150.0000	150.0	0.0	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.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL: 0-2217-3000-24 FAX: 0-2719-9484



Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenExcellence
Serial No. : B834291445
ID No. : RYG_EN0152
Condition As-Received : Used Item

Received Date : 08 December 2023
Calibration Date : 15 December 2023

Reference : 2312-0151DSC-3
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd., Rayong Branch

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

Calibrated by : Warakorn Lemgagrakul

Approved by :
Approved Signatory

() Saitip Meangma
() Warakorn Lemgagrakul
(x) Ponpan Paipim

Issue Date : 19 December 2023

The Uncertainties are for a confidence probability of approximately 95 %

This certificate is valid only for the equipment and conditions specified. Any other use is at the user's risk.
Approved by the head of Corporate Services & Equipment Calibration and Testing Services

1193422

A 0061696



Cert.No.: 23CH1574
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	913598	14 July 2025
pH 6.986	CPA chem	931959	01 Oct 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 (±mV)	Coverage factor k
			mV	pH		
pH Meter S/N.: B834291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 23CH1574
Page: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 3225368	4.008	4.013	184.1	0.0045	2.00
	6.986	6.998	8.7	0.0084	2.00
	9.997	10.002	-164.7	0.0089	2.11

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM
- Serial No. : 3225368

Dimension of probe;

- Length : 120 mm
- Diameter : 12 mm
- Immersion Depth : 100 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (±°C)	Coverage factor k
25.0	25.003	24.3	-0.703	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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a 1193852

a 1193851

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



NSC-TIS-15 17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius

Certificate No. : 24BCI0089
Issued Date : Friday, February 23, 2024
Reference No. : 229186
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.Pluakdaeng, Rayong 21140, Thailand.

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

Metrolological data :
Capacity : 220 g Readability : 0.0001 g

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

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 the International Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrolological 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 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)



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8361-6 Fax: +66 2843 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius

Certificate No. : 24BCI0089
Issued Date : Friday, February 23, 2024
Reference No. : 229186
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 readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.		The off-center loading error is yielded by the difference between the median of the load, i.e. 10 or 14 of maximum capacity, placed in the median of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).	
Nominal Value : (Low Load)	20.0000 g	Nominal value :	100 g
Tolerance	0.0001 g	Tolerance	0.0004 g
Nominal Value : (High Load)	200 g		
Tolerance	0.0001 g		
Standard Deviation 0.00007 0.00006		Difference	

Linearity

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

Tolerance 0.0002 g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00018
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.



Certificate of Calibration

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

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UFE 500
Serial No. : G511.1572
ID No. : RYG_EN0010
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140 Thailand
Location : Oven Room
Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpalboon
Approved by :
() Pornthippa Tameyakul
() Unnopphol Harachal
(✓) Suwit Imjai

REVIEW BY

APPROVED BY

NEXT CAL DATE : 21/09/25



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

Cert. No.: 24TM632
Page : 2 of 3

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

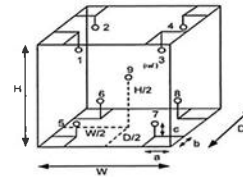
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :-

Function of UUC* : Temperature Source
Fresh air setting : Close

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



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 = 0.49 m
Capacity = 0.11 m³

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

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-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	103.817	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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Certificate of Calibration

Cert.No.: 23CH1088
Page : 1 of 2

Equipment : Conductivity Meter
Manufacturer : Mettler Toledo
Model : S230
Serial No. : B241407147
ID No. : RYG_EN0029
Condition As-Received : Used Item
Received Date : 01 September 2023
Calibration Date : 04 September 2023
Reference : 2309-0010DSC-7
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu,
A.Pluckdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In -house method :
- CP-CH6 : based on direct measurement by using certified reference material (CRM)
Calibrated by : Warakorn Lernagagrakul
Approved by :
(✓) Saihip Meangmai
() Warakorn Lernagagrakul
() Ponpan Paipim
Issue Date : 7 September 2023

REVIEW BY

APPROVED BY

NEXT CAL DATE : 04/09/25

The Uncertainties are for a confidence probability 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 Pattanapongpaiboon
Approved by :
() Pornthipha Tameyakul
() Unnopphol Harachai
(✓) Suwit Imjal
Issue Date : 23 March 2024

REVIEW BY
APPROVED BY
NEXT CAL DATE 21/09/25



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.

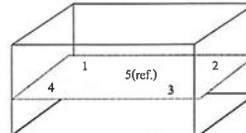
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
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

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
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.: 24CH1080
Page.: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : C232588428
ID No. : RYG_FS0606
Condition As-Received : Used Item
Received Date : 29 August 2024
Calibration Date : 30 August 2024
Reference : 2408-0988DSC-3
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5, T.Maenam Khu,
A.Pluckdaeng, 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 :
() Unnopphol Harachai
() Ponpan Paipim
(✓) Sathip Meangmai
Issue Date : 2 September 2024

REVIEW BY
APPROVED BY
NEXT CAL DATE 30/08/25

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 24CH1080
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	58440003	130RC120	23E3607	13 Nov 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 Hach Lenge GmbH Ltd.,
Deutsche Akkreditierungsstelle, Accredited No. D-RM-15184-01-00
: 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 4.006	Hach Lenge GmbH	C03146	23 Feb 2026
pH 7.000	Hach Lenge GmbH	C03020	13 Dec 2024
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	Coverage factor
	pH	mV	mV	pH	($\pm$ mV)	k
pH Meter S/N : C232588428	4.00	177.48	178	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 : 3293229	4.006	4.02	181	0.0091	2.05
	7.000	7.00	7	0.0092	2.05
	9.997	10.00	-168	0.011	2.07

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.: 24LM140
Page.: 1 of 2

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : C232588428
ID No. : RYG_FS0606

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 : 29 August 2024
Calibrated Date : 30 August 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Warakorn Lemgagrakul

Approved by :

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

Issue Date : 02 September 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2408-0988DSC-4

Cert. No.: 24LM140
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	20410013	24I851	TPA	08 Aug 2025

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 : 3293229

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.001	25.1	0.099	0.16	2.00
30.0	100	30.004	30.1	0.096	0.16	2.00
40.0	100	40.004	40.2	0.196	0.16	2.00
50.0	100	50.003	50.2	0.197	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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Cert. No.: 23TM1408
Page : 1 of 4

Certificate of Calibration

Equipment : Autoclave
Manufacturer : TOMY
Model : SX-700
Serial No. : 48134180
ID No. : BKK_ML0041

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

Received Order : 03 October 2023
Calibration Date : 04 October 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Khul Rutianaprapachai

Approved by :

() Pornthippa Tamayakul
(✓) Ponpan Paipim
() Suwit Imjai

Issue Date : 11 October 2023

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2310-0006OC-6
Procedure Used :-
Cert. No.: 23TM1408
Page : 2 of 4

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013823	23LM66	TPA	25 Mar 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.

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

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

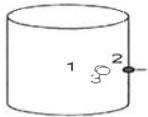
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

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

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

Result of Calibration : (*) Without Adjustment

Function of UUC* : Temperature Source



	Environmental		
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	26	64	221
Finished of Calibration	27	67	222

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	19-17TC-08
2 =	Temperature sensor	19-17TC-09
3 =	Exhaust port	19-17TC-10

a 1184533



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2310-0006OC-6
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source
Cert. No.: 23TM1408
Page : 3 of 4

Operating parameter Set : Temperature = 108 °C

		Sterilization period = 10 minute		Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)				
108	108	1	108.352	0.12	0.04	0.90	2
		2	108.263				
		3	108.140				

Operating parameter Set : Temperature = 115 °C

		Sterilization period = 20 minute		Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)				
115	115	1	115.376	0.13	0.08	0.90	2
		2	115.297				
		3	115.157				

Operating parameter Set : Temperature = 118 °C

		Sterilization period = 10 minute		Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)				
118	118	1	118.083	0.11	0.09	0.90	2
		2	118.037				
		3	117.954				

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

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

UUC* : Unit Under Calibration

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

a 1184532



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2310-0006OC-6
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source
Cert. No.: 23TM1408
Page : 4 of 4

Operating parameter Set : Temperature = 121 °C

Sterilization period = 30 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
121	121	1	121.166	0.17	0.11	0.91	2
		2	121.082				
		3	120.980				

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

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

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was excluded stability.

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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Cert. No.: 23TM1446
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : SHEL-LAB
Model : 1915A
Serial No. : 0200599
ID No. : BKK_ML0010

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

Location : Incubation & Micrological Reading

Received Order : 17 July 2023
Calibration Date : 17 July 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Patianapongpaiboon

Approved by :
Approved Signatory

() Pongthippa Tameyakul
(/) Malee Butkruea
() Suwit Imjai

Issue Date : 24 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services or Equipment Calibration and Testing Services

a 1184531

A 0056489



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2307-0285OC-1
Procedure Used :-

Cert. No.: 23TM1146
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49001451	23LM27	TPA	25 Feb 2024

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

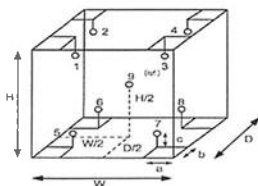
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

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

Dimension of Chamber :

D = 0.50 m
W = 0.75 m
H = 1.2 m
Capacity = 0.45 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	24
REL.Humid. (%)	54	56
AC Supply (Volt)	221	223

Position :	Ref. Std. ID No.:
1	19RTD-2/1
2	19RTD-2/2
3	19RTD-2/3
4	19RTD-2/4
5	19RTD-2/5
6	19RTD-2/6
7	19RTD-2/7
8	19RTD-2/8
9 (ref.)	19RTD-2/9



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2307-0285OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM1146
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor
35.0	35.0	35.0	0.055	0.30	0.44	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	34.888	34.933	34.815	34.813	35.064	35.019	35.156	35.141	35.087	0.30

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



Certificate of Calibration

Cert. No.: 24TM667
Page : 1 of 3

Equipment : Hot Air Oven
Manufacturer : Binder
Model : ED 240/E2
Serial No. : 00-15533
ID No. : BKK_ML0013

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

Received Order : 23 April 2024
Calibration Date : 23 April 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Tawatchai Pama

Approved by :

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

Issue Date : 26 April 2024



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2404-0438OC-8
Procedure Used :-

Cert. No.: 24TM667
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49001451	24LM44	TPA	17 Mar 2025

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.

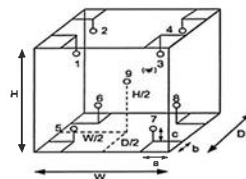
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	23
REL.Humid. (%)	65	65
AC Supply (Volt)	223	222



Probe Installation Details :

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

Dimension of Chamber :

D = 0.50 m
W = 0.80 m
H = 0.80 m
Capacity = 0.24 m³

Position :	Ref. Std. ID No.:
1	24-19TC-01
2	24-19TC-02
3	24-19TC-03
4	24-19TC-04
5	24-19TC-05
6	24-19TC-06
7	24-19TC-07
8	24-19TC-08
9 (ref.)	24-19TC-09

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2404-0439OC-8
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No.: 24TM667
 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
180	180	180	0.64	2.7	3.7	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
180	181.009	181.511	180.922	181.359	181.217	183.659	181.654	181.986	181.474	1.5

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.: 24TM469
 Page : 1 of 3

Equipment : Water Bath
 Manufacturer : Memmert
 Model : WNE 45
 Serial No. : L712.0429
 ID No. : BKK_ML0056

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
 104 Phatthanakan 40, Phatthanakan Rd.,
 Khwaeng Phatthanakan, Khet Suan Luang,
 Bangkok 10250 Thailand
 Location : Incubation \$ Microbiological Reading

Received Order : 01 March 2024
 Calibration Date : 01 March 2024
 Ambient Temperature : (26 ± 10) °C
 Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by :
 () Pongthippa Tameyakul
 () Unnopphol Harachai
 (✓) Suwit Imjai

Issue Date : 4 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Water Bath
 Condition As-Received : Used Item
 Reference : 2403-0001OC-1
 Procedure Used :-

Cert. No.: 24TM469
 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.

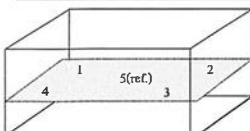
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	55	221
Finished of Calibration	23	56	220



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 : 2403-0001OC-1
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source

Cert. No.: 24TM469
 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.)	
44.5	44.5	44.5	44.469	44.462	44.492	44.510	44.496	0.15
45.0	45.0	45.0	44.975	44.974	45.007	45.023	44.999	0.15

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
44.5	0.087	0.029	2
45.0	0.069	0.031	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert.No.: 24CH774
Page.: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : C22115514
ID No. : RYG_FS0596
Condition As-Received: Used Item
Received Date : 28 June 2024
Calibration Date : 01 July 2024
Reference : 2406-0969DSC-6
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)

REVIEW BY *Pittaya T.*
APPROVED BY *Sut S.*
NEXT CAL DATE: 01/07/25

Calibrated by : Warakorn Lemgagrakul
Approved by : *Saithip*
Approved Signatory

() Unnopphol Harachai
() Ponpan Paipim
(✓) Saithip Meangmai
Issue Date : 03 July 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No.: 24CH774
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	23E2602	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	Coverage factor
	pH	mV	mV	pH	($\pm$ mV)	k
pH Meter S/N.: C22115514	4.00	177.48	178	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.: 3293232	4.008	4.01	180	0.0079	2.00
	6.986	6.99	5	0.011	2.00
	9.997	10.00	-172	0.0092	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert. No.: 24LM108
Page.: 1 of 2

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : C22115514
ID No. : RYG_FS0596
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 ± 1) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Warakorn Lemgagrakul
Approved by : *Suwit*
Approved Signatory

() 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-7

Cert. No.: 24LM108
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	2311216	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.

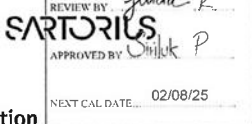
This instrument was connected with temperature sensor, S/N.: 3293232

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	25.003	25.1	0.097	0.16	2.00
30.0	100	30.002	30.2	0.198	0.16	2.00
40.0	100	40.003	40.2	0.197	0.16	2.00
50.0	100	50.002	50.2	0.198	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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Certificate of Calibration

Model Number: M5E224S-100-BU
Description: Analytical Balance
Serial Number: 0027405555
ID No.: BKK_EN0003
Manufacturer: Sartorius
Certificate No.: 24BC0270
Issued Date: Monday, August 05, 2024
Reference No.: 240942
Page No.: 1 of 2

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

Calibrated Place: Lab Room

Calibrated By: Mr. Chonchai Intana
Calibration Date: Friday, August 02, 2024

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Ambient Conditions:
Temperature: 23.0 °C ± 5.0 °C
Humidity: 55.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration
☒ New Installation ☐ Service / Repair ☒ Recalibration / 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 form of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YC5011-522-00	Sartorius weight set 1000g E2 YC5011-522-00	TCS	M23081975	23-Aug-2025
Testo 174 H	Thermo-Hygrometer, Testo 174 H	ENIECH	M7 661303 H661140	12-Nov-2024

This certificate is valid 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 Intana (Technical Manager)



SOP FM 33 02 February 2022



Certificate of Calibration

Model Number: M5E224S-100-BU
Description: Analytical Balance
Serial Number: 0027405555
ID No.: BKK_EN0003
Manufacturer: Sartorius
Certificate No.: 24BC0270
Issued Date: Monday, August 05, 2024
Reference No.: 240942
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 results under constant test conditions when the same load within a measurement range 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 pointed by the difference between the result of the load, 1/2 or 1/4 of maximum capacity placed at the middle of the weighing pan and between each of four additional measurement points (1 positions defined according to OIML R113).	
Nominal Value: (Low Load)	20.0000 200.0000	Nominal value:	100 g
20 g	20.0000 199.9999	Tolerance	0.0004 g
Tolerance	0.0001 g	Difference	
Nominal Value: (High Load)	20.0000 200.0000	1 0.0000	
200 g	20.0000 200.0001	2 0.0000	
Tolerance	0.0001 g	3 0.0000	
Standard Deviation	0.00004 0.00006	4 0.0001	
		5 0.0001	
		6 -	

Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayd Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00015
0.1	0.1000	0.1000	0.0000	0.00015
1	1.0000	1.0000	0.0000	0.00015
2	2.0000	2.0000	0.0000	0.00015
5	5.0000	5.0000	0.0000	0.00015
10	10.0000	10.0000	0.0000	0.00015
20	20.0000	20.0000	0.0000	0.00015
50	50.0000	50.0001	0.0001	0.00016
100	100.0000	100.0001	0.0001	0.00019
200	200.0000	200.0002	0.0002	0.00029

End of Report

SOP FM 33 02 February 2022

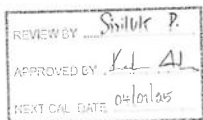
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhro, Saraburi 18110, Thailand.
Saraburi Tel: +66 3627 3096 Fax: +66 3627 3100
Bangkok Tel: +668 9205 6851, +668 8247 2360
Website: www.scieco.co.th E-Mail: calibrate@scg.com

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhro, Saraburi 18110, Thailand.

Certificate No. T231303 Page 1 of 3

Certificate of Calibration

Equipment: Liquid Bath (Water)
Manufacturer: MEMMERT
Model: WNB29
Serial No.: L611.0135
Customer Code: BKK_EN0148
ID No.: T6455A4
Customer: ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250
Customer Location: ORGANIC PREPARATION LAB
Date of Receipt: 27 June 2023
Calibrated By: Sujjar Naknakred (Site Calibration Manager)
Approved By: Boonchai Suriyawong (Site Calibration Manager)
Date of Issue: 11 JUL 2023



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

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

PNP-14110-31-05-14

Certificate No. T231303

Calibration Report

Page 2 of 3

Equipment: Liquid Bath (Water)
Date of Calibration: 4 July 2023
Environment: Temperature: 22.2-22.5 °C
Line Voltage: 221.6-224.8 V
Relative Humidity: 55 - 65 %RH

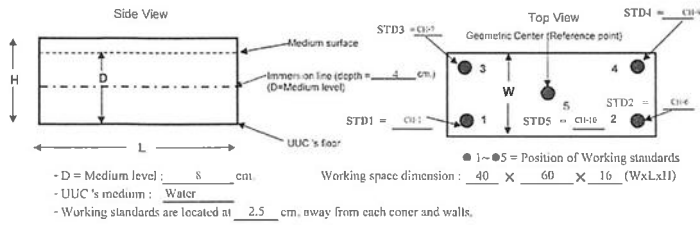
Condition of this results of calibration:

- This equipment was calibrated by insert five resistance thermometer detectors into its water bath, the other one thermocouple type T use for ambient temperature measurement. The calibration was done in according to WI-T26 (based on ASTM E715-80 (Reapproved 2001)). All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS-90.
- Reference Standard Instrument:
Instrument Model Instrument No. Certificate No. Due Date
RTD 100 OIM M18 (CH1-CH6-CH7, CH9-CH10) T230545 10 April 2024
DATA LOGGER 34970A T149 T230545 10 April 2024
- This certificate is traceable to:
National Institute of Metrology (Thailand) through Metrological Center (NSC-TLS-TIS 17025 CALIBRATION 0244)
- Condition of calibrated item: good
Equipment Description:
Time Constant 3 Hour 45 Minute At 60 °C
- Adjustment:
(X) without adjustment () after adjustment

Approved By: [Signature]

PNP-14110-31-05-14

Calibration Report



Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)				
	CH-1	CH-6	CH-7	CH-9	CH-10
60	60.03	60.06	60.24	60.11	60.18
85	84.79	84.83	85.42	85.05	85.20
95	93.71	93.83	94.62	94.15	94.42

Liquid Bath (Water)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (± °C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max					
61.0	60.9	61.1	61.0	0.13	0.19	0.29	2.04
86.0	85.8	86.2	86.0	0.19	0.47	0.44	2.17
95.0	94.6	95	94.9	0.32	0.65	0.55	2.13

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

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

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

Approved By: 