

# ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



1 <http://www.who.int>



Parameter	Value	Allowable Range	Check
$\alpha_1$	-2.4	$-10^\circ < \alpha_1 < +10^\circ$	OK
$\alpha_2$	-1.2	$-10^\circ < \alpha_2 < +10^\circ$	OK
$\beta_1$	-2.0	$-5^\circ < \beta_1 < +5^\circ$	OK
$\beta_2$	1.3	$-5^\circ < \beta_2 < +5^\circ$	OK
$\gamma$	0.3	-	-
$\theta$	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125^\circ$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031^\circ$	OK
$Dt$	0.310	$0.188^\circ \leq Dt \leq 0.375^\circ$	OK
$A/2dt$	1.468	$1.05 \leq A/2dt \leq 1.5$	OK
$A$	0.91	$2.10t \leq A \leq 3dt$	OK

Approved By: Natthapol Jengwareewong  
(Mr. Natthapol Jengwareewong)  
RYG Field Services Specialist (I)

FORM NO. F06-124 REVISION NO. 0 ISSUE DATE: 25/12/79

2 singlehal.com

*D. Wuttke*  
Mrs. Rongluck Wuttke  
Technical Manager

Received 26 April 2006

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3 englischel.c

Issued Date: 24/02/20

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# ROTA METER CALIBRATION RESULT APRIL 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
SGK_F50136	23 Apr 24	$Y = 1.0134x + 3.6467$	1.0000
SGK_F50138	04 Apr 24	$Y = 1.0449x + 0.3684$	0.9988
SGK_F50139	04 Apr 24	$Y = 1.0086x + 3.1267$	0.9988
SGK_F50140	04 Apr 24	$Y = 1.0029x + 7.5181$	1.0000
SGK_F50141	23 Apr 24	$Y = 1.1126x + 0.0619$	0.9997
SGK_F50142	23 Apr 24	$Y = 1.0136x + 2.4267$	0.9999
SGK_F50143	23 Apr 24	$Y = 1.0036x + 8.3162$	1.0000

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

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

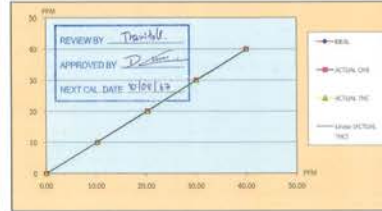


# TEST REPORT

CUSTOMER NAME	ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส ลैบอราทอรี กรุ๊ป จำกัด)		
EQUIPMENT NAME	THC Analyzer		
MANUFACTURER	HORIBA	MODEL	APHA-370
STANDARD GAS CONCENTRATION (PPM) (CH4)	50.1 PPM	SERIAL NO.	143007HE
CYLINDER NO.		CYLINDER NO.	CC734373
CYLINDER PRESSURE (psig)	1,600 PSI	CERTIFIED DATE	12/05/2020
CERTIFIED BY	ANGAS	EXPIRED DATE	12/05/2028

## TEST RESULTS

POINT NO	IDEAL	ACTUAL CH4	ERROR CH4	IDEAL THC	ACTUAL THC	ERROR THC
ZERO	0.00	0.00	0.00	0.00	0.00	0.00
1	10.00	10.21	0.21	10.18	10.18	0.00
2	20.00	20.30	0.30	20.23	20.23	0.00
3	30.00	30.10	0.10	30.19	30.19	0.00
4	40.00	40.00	0.00	40.00	40.00	0.00
AVERAGE (%)			0.98			0.90



CALIBRATED BY:   
CHECKED BY:   
DATE: 10/2/24  
NAC

ผลการสอบเทียบ: ผลการสอบเทียบเป็นไปตามข้อกำหนดที่กำหนดไว้  
วันที่ 15/14-15/17/25-24 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511



# CHECK LIST

CUSTOMER NAME	ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส ลैบอราทอรี กรุ๊ป จำกัด)		
EQUIPMENT NAME	THC Analyzer		
MANUFACTURER	HORIBA	MODEL	APHA-370
SERIAL NO.	143007HE		

NO.	THC Analyzer (APHA - 370)	UNIT	BEFORE	AFTER
1	Signal (CH4)	mV	64.20	35.60
2	Signal (THC)	mV	68.10	46.70
3	Detector	Temp °C, Standard Value: Ambient Temp(25°C)±3°C	47.40	47.30
4	Detector	Pressure MPa, Standard Value: Ambient(1013 to 1013.25 hPa)	101.25	101.25
5	Detector	°C, Standard Value: 300 °C to 430 °C	100.75	100.80
6	Purifier	MPa, Normal Value: 8 MPa to 25 MPa	9.90	9.90
7	IR44C	°C, Standard Value: 250 °C to 340 °C	241.20	241.20
8	DC 24 V	V, Standard Value: 24 V ± 0.5 V	23.90	23.90
9	DC 5 V	V, Standard Value: 5 V ± 0.5 V	5.00	5.00
10	Bypass (Optional)	L/min, Normal Value: 0.9 L/min ± 0.3 L/min	-	-
11	Flow Flow (Optional)	L/min, Standard Value: 0.8 L/min or More	-	-
12	CH4 Sampling Reading	PPM	5.30	5.10
13	IR44C Sampling Reading	PPM	0.11	0.45
14	THC Sampling Reading	PPM	5.40	2.60
15	Zero Gas CH4/THC	PPM	0.10/0.17	0.00/0.00
16	Span Gas	PPM	58.63/55.20	40.00/40.00
17	Gas Mix	PPM	20	20

Remark: Reference: EX-EN-017-06, Ambient HC Monitor APHA-370 Operation Manual Page 881

Remark: (1) Ambient temperature: 3°C to 40°C

## การบำรุงรักษา

-Service Maintenance

ตรวจสอบและทำความสะอาด

เปลี่ยน Filter 12 เดือน, 1 ปี Calibration Zero/Gas, Multi-point

ผลการสอบเทียบ

-ผลการสอบเทียบเป็นไปตามข้อกำหนดที่กำหนดไว้

CALIBRATED BY:   
CHECKED BY:   
DATE: 10/2/24  
NAC

ผลการสอบเทียบ: ผลการสอบเทียบเป็นไปตามข้อกำหนดที่กำหนดไว้  
วันที่ 15/14-15/17/25-24 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511 สอบเทียบ: 1,511

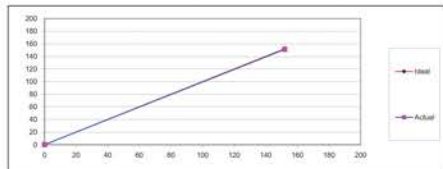


# CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment ID	BKX_F50758
Equipment Name	FID Analyzer	Manufacturer	Baseline Moon
Model	9000H	Serial No.	031SEF0047
Std Gas Conc. (ppm)	152	Cylinder No.	D878173
Certified Date	27-Jun-18	Expired Date	27-Jun-26

## CALIBRATION RESULTS

Point	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
SPAN	152.00	151.20	-0.80	-0.53
AVERAGE (%)				-0.21



Calibrated By:   
(Mr. Apisit Singha)  
Field Environmental Scientist (4)

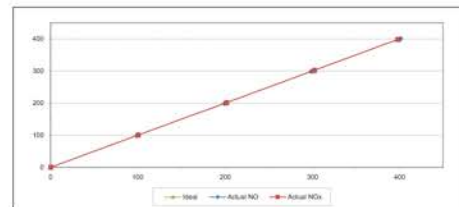
Approved By:   
(Mr. Sarayuth Jittrantorn)  
Assistant General Manager



# MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APHA-370
Serial No.	148EH0E0	Equipment ID	BKX_FS1064
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Angas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.70	0.70	0.70
2	200.00	199.40	-0.60	-0.30	201.40	1.40	0.70
3	300.00	298.50	-1.50	-0.50	302.30	2.30	0.77
4	400.00	401.40	1.40	0.35	398.30	-1.70	-0.42
AVERAGE (%)				-0.25			0.37



Calibrated By:   
(Mr. Jirawat Sakorn)  
Field Environmental Scientist (3)

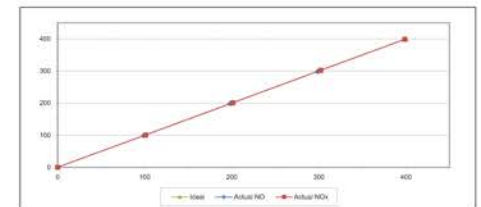
Approved By:   
(Mr. Sarayuth Jittrantorn)  
Assistant General Manager



# MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	2198	Equipment ID	RYG_F50252
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Angas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.70	-0.30	-0.30	101.00	1.00	1.00
2	200.00	198.00	-2.00	-1.00	201.20	1.20	0.60
3	300.00	298.50	-1.50	-0.50	302.30	2.30	0.77
4	400.00	398.20	-1.80	-0.45	398.70	-1.30	-0.33
AVERAGE (%)				-0.63			0.43



Calibrated By:   
(Mr. Jirawat Sakorn)  
Field Environmental Scientist (3)

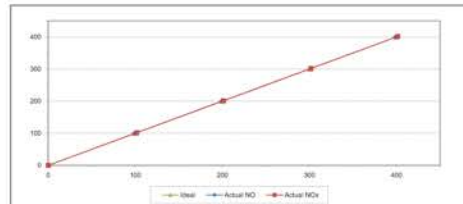
Approved By:   
(Mr. Sarayuth Jittrantorn)  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-24 Equipment Name NOx Analyzer  
Manufacturer HORIBA Model APNA-370  
Serial No. ALP0V0VWY Equipment ID RYG\_F80455  
Calibrator Manufacturer Teledyne API Model 700  
Serial No. 947  
Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0207222  
Cylinder Pressure (psi) 1800 Certified By Algas Inc.  
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS							
	Islet	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx	
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10	
1	100.00	99.60	-1.40	-1.40	101.60	1.60	1.60	
2	200.00	199.80	-1.20	-0.60	201.20	1.20	0.60	
3	300.00	301.00	1.00	0.33	301.80	1.80	0.60	
4	400.00	398.50	-1.50	-0.38	401.30	1.30	0.33	
AVERAGE (%)				-0.39			0.64	



Calibrated By

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

Approved By

(Mr. Sanyuth Jittrant)  
Assistant General Manager

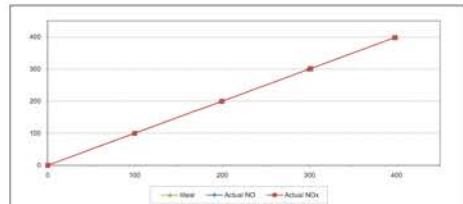
ALS Laboratory Group  
FORM NO. F-06-038 REVISION NO. 1 ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-24 Equipment Name NOx Analyzer  
Manufacturer HORIBA Model APNA-370  
Serial No. BG314J3K Equipment ID RYG\_F80264  
Calibrator Manufacturer Teledyne API Model 700  
Serial No. 947  
Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0207222  
Cylinder Pressure (psi) 1800 Certified By Algas Inc.  
Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS							
	Islet	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx	
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10	
1	100.00	99.20	-0.80	-0.80	100.10	0.10	0.10	
2	200.00	199.50	-0.50	-0.25	199.30	-0.70	-0.35	
3	300.00	298.60	-1.40	-0.47	301.50	1.50	0.50	
4	400.00	398.20	-1.80	-0.45	398.00	-2.00	-0.50	
AVERAGE (%)				-0.45			-0.03	



Calibrated By

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

Approved By

(Mr. Sanyuth Jittrant)  
Assistant General Manager

ALS Laboratory Group  
FORM NO. F-06-038 REVISION NO. 1 ISSUE DATE: 02/04/12

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Agilent CrossLab Compliance Services

## Certificate of System Qualification

GC-QG - GCMS-QG

System ID: RYG\_E01036  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 819/10, Moo 5, Tambol Mae Nam Khu, Phasi Deang, Rayong 21140, Thailand

Date: January 5, 2024 10:50:24 AM  
EQP Name: AgilentRecommended, AgilentRecommended  
EQP Revision: GC02.04, GCMS02.04  
Overall Qualification Status: Pass

REVIEW BY: *D. Jittrant*  
APPROVED BY: *D. Jittrant*  
NEXT CAL. DATE: 02/04/25

CDS Legen Verification - GC

Legen: chonkha.hurkane

Overall CDS Legen Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setup Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front: SSL

Setup Status: Pass

Setpoint Status: Setpoint Actual

Inlet Pressure: 25.0 psi 25 psi

Accuracy: 0.0 psi

Agilent Recommended: &lt;= 1.2

Date: January 5, 2024 10:50:24 AM  
System ID: RYG\_E01036

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 229 °C

Accuracy: -1.0 °C

Agilent Recommended: &gt;= -1.0 % setpoint in K (-5.0 °C)

&lt;= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 100.8 °C

Accuracy: 0.8 °C

Agilent Recommended: &gt;= -1.0 % setpoint in K (-3.7 °C)

&lt;= 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: 100.0 100.8167 °C

Stability: 0.1 °C

Agilent Recommended: &lt;= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Date: January 5, 2024 10:50:24 AM  
System ID: RYG\_E01036

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Agilent CrossLab Compliance Services

Log Amp

Tested Combination1

Name: 59778

Setpoint Status: Pass

Front: SSL / External SQ

Overall Log Amp Test Status

Pass

RPFA

Tested Combination1

Name: 59778

Setpoint Status: Pass

Front: SSL / External SQ

Attc: 100 mV

Drift After Five Minutes:

5 nV

RPFA Voltage:

508 mV

Agilent Recommended: &gt;= -100 and &lt;= 100 &lt;= 1100

Overall RPFA Test Status

Pass

Tune E1

Tested Combination1

Name: 59778

Setpoint Status: Pass

Front: SSL / External SQ

Flame: 1

Setpoint Status: Pass

Flame: 2

Overall Tune E1 Test Status

Pass

Scouting Run

Date: January 5, 2024 10:50:24 AM

System ID: RYG\_E01036

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Agilent CrossLab Compliance Services

Tested Combination1

Front: SSL / External SQ

Manual Injection

Name: Not applicable

Source: E1 - Extractor

Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Signal to Noise E1

Tested Combination1

Name: 59778

Front: SSL / External SQ

Source: E1 - Extractor

Flame: 1

Setpoint Status: Pass

Signal to Noise: 5113

Agilent Recommended: &gt;= 1200

Source: E1 - Extractor

Flame: 2

Setpoint Status: Pass

Signal to Noise: 4456

Agilent Recommended: &gt;= 1200

Overall Signal to Noise E1 Test Status

Pass

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

Date: January 5, 2024 10:50:24 AM  
System ID: RYG\_E01036

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## Instrument Details

## Purpose

This section describes the as found system configuration.

## Details

## System

System ID	RYO_EN0136
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

## Tested Combination 1

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	CN16483258
Firmware Revision	9.02.04.3
Component ID/Asset No.	061117000236
Own Type	Standard

Date: January 5, 2024 10:53:24 AM  
System ID: RYO\_EN0136

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## Inlet 1

Manufacturer	Agilent Technologies
Name	7890
Type	SL
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	MS
Name	9277B
Model Number	G7077B
Serial Number	US17014658
Firmware Revision	9277 8.00.34
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

## Component ID/Asset No.

061117000236

## MS E1 Source 1

Manufacturer	Agilent Technologies
Source Type	E1 - Extractor

## Number of Elements

2

Date: January 5, 2024 10:53:24 AM  
System ID: RYO\_EN0136

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## Electronic Signature

## Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and 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:	Ekram Puangpa
Logged On User Name:	ekram_puangpa@agilent.com
Signature Creation Date:	January 5, 2024
Reason for Signature:	Executed protocol and published the original version of document.

## Regulatory Disclaimer

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

## Warranty

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Date: January 5, 2024 10:53:24 AM  
System ID: RYO\_EN0136

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User Name: ekram_puangpa Report Generated by Method: ADR7000076 System ID: RYO_EN0136 Print Date: January 5, 2024 10:53:24 AM				
ALX_O6_RYO_EN0136 Transaction log				
Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:57:51 AM	Auto	System Check	Session	None
January 4, 2024 10:58:01 AM	Start	Configuration	Session	None
January 4, 2024 10:57:51 AM	Auto	End Screen	Logging	User is Field Engineer and does not require protocol jobs
January 4, 2024 10:58:28 AM	Auto	Exp Loaded	Session	EQP needs for primary instrument (EQP) File path: Protocol\Pack\G3442B\Comp\G3442B_001_001.mpl EQP File Name: G3442B_001_001.mpl EQP Name: Agilent\G3442B_001_001.mpl EQP needs for Agilent\G3442B_001_001.mpl EQP Name: Agilent\G3442B_001_001.mpl
January 4, 2024 10:58:40 AM	End	Configuration	Session	None
January 4, 2024 10:58:44 AM	Start	Qualification	Session	EQ
January 4, 2024 10:58:44 AM	Start	Execution	CDS Logic Verification (CDS - 1980 - Qualitative test)	None
January 4, 2024 10:58:50 AM	End	Execution	CDS Logic Verification (CDS - 1980 - Qualitative test)	Run Count: 1

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Date: January 5, 2024 10:53:24 AM  
System ID: RYO\_EN0136

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User Name: ekram_puangpa Report Generated by Method: ADR7000076				System ID: RYO_EN0136 Print Date: January 5, 2024 10:53:24 AM
ALX_O6_RYO_EN0136 Transaction log				
Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:58:50 AM	Start	Execution	System Inspection and Basic Safety and Operation - 1980 - Qualitative Test - No defects observed	None
January 4, 2024 10:58:50 AM	End	Execution	System Inspection and Basic Safety and Operation - 1980 - Qualitative Test - No defects observed	Run Count: 1
January 4, 2024 10:58:52 AM	Start	Execution	Self Pressure Assembly - Front	None
January 4, 2024 10:58:52 AM	End	Execution	Self Pressure Assembly - Front	Run Count: 1
January 4, 2024 10:58:52 AM	Start	Execution	Self Pressure Assembly - Front	None
January 4, 2024 10:58:52 AM	End	Execution	Self Pressure Assembly - Front	Run Count: 1
January 4, 2024 10:58:52 AM	Start	Execution	Self Pressure Assembly - Front	None
January 4, 2024 10:58:52 AM	End	Execution	Self Pressure Assembly - Front	Run Count: 1
January 4, 2024 10:58:52 AM	Start	Execution	Self Pressure Assembly - Front	None
January 4, 2024 10:58:52 AM	End	Execution	Self Pressure Assembly - Front	Run Count: 1
January 4, 2024 10:58:52 AM	Start	Execution	Self Pressure Assembly - Front	None
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January 4, 2024 10:58:52 AM	Start	Execution	Self Pressure Assembly - Front	None
January 4, 2024 10:58:52 AM	End	Execution	Self Pressure Assembly - Front	Run Count: 1
January 4, 2024 10:58:52 AM	Start			

[illegible]

Date: January 5, 2024 10:53:24 AM  
System ID: RYG\_EN0136

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User Name: colabun\_pumpkin

Report Generated by: Machinara    ABR71000104

System ID: RPG\_030760

Print Date: January 5, 2024 10:25:40

ALCA\_DG\_RPG\_030760\_Transaction Log

Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
<a href="#">January 5, 2024 9:23:30 AM</a>	End	Qualification	Success	OK
<a href="#">January 5, 2024 9:25:00 AM</a>	End	Rebuilding	Success	None
<a href="#">January 5, 2024 9:27:40 AM</a>	End	Rebuilding	Success	None
<a href="#">January 5, 2024 9:27:40 AM</a>	Start	Qualification	Success	OK
<a href="#">January 5, 2024 9:27:40 AM</a>	Execution	Signal to Nodes E1 - Client Ingestion, Point 326, 302 - Success E1 - Execution using Fluxment 1 - L1 => 1000		None
<a href="#">January 5, 2024 9:33:10 AM</a>	Avail	Data	Signal to Nodes E1 - Client Ingestion, Point 326, 302 - Success E1 - Execution using Fluxment 1 - L1 => 1000	<div>Data File Path:</div> <div>C:\OCCASION\RPG_030760</div>
<a href="#">January 5, 2024 9:40:22 AM</a>	End	Evaluation	Signal to Nodes E1 - Client Ingestion, Point 326, 302 - Success E1 - Execution using Fluxment 1 - L1 => 1000	Run Count: 1
<a href="#">January 5, 2024 9:40:22 AM</a>	End	Execution	Signal to Nodes E1 - Client Ingestion, Point 326, 302 - Success E1 - Execution using Fluxment 1 - L1 => 1000	None
<a href="#">January 5, 2024 9:58:13 AM</a>	Avail	Data	Signal to Nodes E1 - Client Ingestion, Point 326, 302 - Success E1 - Execution using Fluxment 1 - L1 => 1000	<div>Data File Path:</div> <div>C:\OCCASION\RPG_030760</div>
<a href="#">January 5, 2024 10:00:10 AM</a>	End	Evaluation	Signal to Nodes E1 - Client Ingestion, Point 326, 302 - Success E1 - Execution using Fluxment 1 - L1 => 1000	Run Count: 1

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Date: January 8, 2026 10:53:24 AM  
System ID: RYG\_EN0136

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User Name: edwinr\_guerrero

System ID: RPTG\_000008

Report Generated by: Webtronic: A887020073

Print Date: January 5, 2024 10:20:00 AM

AL1\_Q0\_RPTG\_RPTG000008

Time	Transaction Date	Activity	Type of Transaction	Optional Information
January 1, 2024 10:00:00	Auto	Transaction	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	Deletion Set for Run Count 1
January 5, 2024 10:00:00	Start	Execution	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	None
January 5, 2024 10:10:00	Auto	Data	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	Date New Path: 3/00000000_0000
January 5, 2024 10:11:00	End	Execution	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	Run Count: 0
January 5, 2024 10:22:00	Auto	Transaction	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	Deletion Set for Run Count 1
January 5, 2024 10:22:00	Start	Execution	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	None
January 5, 2024 10:23:00	Auto	Data	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	Date New Path: 3/00000000_0000
January 5, 2024 10:23:00	End	Execution	Signal to Hsiao B1 - Credit Inquiry, Point B1L, B0 - Source: B1 - Estimator using Flament 1 - 1 = 100	Run Count: 0

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Date: January 5, 2024 10:53:34 AM  
System ID: RYG\_END138

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User Name, username, password			System ID: RY19, RY19C16	
Report Generated by: Mechanisms: ASD-1000173			Print Date: January 5, 2024 16:53:48	
AUS_2024_RY19_RY19C16.htm:Page 36				
Time	Transmittance Test	Activity Performed	Type of Transmittance	Optional Information
January 5, 2024 15:28:11	Aus01	Test/Inspected	Signal to Noise (S) - Liquid Injection, Front SS, SS - Source: RY - Extensor using Flammant 2 (L) - 1000	Correction Used for Run Count: 3
January 5, 2024 15:28:11	Aus01	Extensor	Signal to Noise (S) - Liquid Injection, Front SS, SS - Source: RY - Extensor using Flammant 2 (L) - 1000	None
January 5, 2024 15:42:05	Aus01	Data	Signal to Noise (S) - Liquid Injection, Front SS, SS - Source: RY - Extensor using Flammant 2 (L) - 1000	Disc Not Path: 2/000000000, 000000
January 5, 2024 15:42:58	Aus01	Extensor	Signal to Noise (S) - Liquid Injection, Front SS, SS - Source: RY - Extensor using Flammant 2 (L) - 1000	Run Count: 4
January 5, 2024 15:43:41	Ext01	Qualification	Session	CG
January 5, 2024 15:44:41	Ext01	Reporting	Session	None
January 5, 2024 15:52:27	Aus01	Reporting	Session	Report Generated: Certificate
January 5, 2024 16:01:27	Aus01	Reporting	Session	Report Generated: Report
January 5, 2024 16:01:28	Aus01	Reporting	Session	Report Generated: Certificate
January 5, 2024 16:12:05	Aus01	Reporting	Session	Report Generated: Report

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Date: January 5, 2004 12:53:24 AM  
System ID: RVD\_EN0126

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## ROTA METER CALIBRATION RESULT JANUARY 2024

Rotameter ID	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKRF_F05085	10 Jan 24	$Y = 1.0351x + 2.7333$	0.9998
BKRF_F05087	10 Jan 24	$Y = 1.0185x + 15.05$	0.9997
BKRF_F05092	10 Jan 24	$Y = 1.0013x + 12.556$	1.0000
BKRF_F05094	10 Jan 24	$Y = 1.0048x + 4.9752$	1.0000
BKRF_F05105	04 Jan 24	$Y = 0.9979x + 13.47$	0.9993
BKRF_F05106	04 Jan 24	$Y = 1.0187x + 1.25$	0.9998
BKRF_F05107	04 Jan 24	$Y = 1.0547x + 2.6055$	0.9981
BKRF_F05107	10 Jan 24	$Y = 1.1547x + 1.6007$	0.9989
BKRF_F05108	04 Jan 24	$Y = 1.127x + 3.3827$	0.9996
BKRF_F05107	04 Jan 24	$Y = 1.0632x + 0.701$	0.9996
BKRF_F05108	04 Jan 24	$Y = 1.0115x + 1.2867$	0.9996
BKRF_F05109	04 Jan 24	$Y = 1.0016x + 4.8467$	1.0000
BKRF_F05126	19 Jan 24	$Y = 0.9618x + 1.9626$	0.9999
BKRF_F05127	19 Jan 24	$Y = 1.0065x + 4.3786$	1.0000
BKRF_F05128	19 Jan 24	$Y = 1.0184x + 37.308$	0.9997
BKRF_F05129	19 Jan 24	$Y = 0.9806x + 2.7825$	0.9977
BKRF_F05130	19 Jan 24	$Y = 0.996x + 1.3266$	0.9999
BKRF_F05131	19 Jan 24	$Y = 1.015x + 27.236$	0.9987
BKRF_F05139	04 Jan 26	$Y = 1.0047x + 8.0297$	0.9997
BKRF_F05140	04 Jan 26	$Y = 1.0059x + 3.9952$	1.0000
BKRF_F05141	04 Jan 26	$Y = 1.0077x + 0.0486$	0.9995
BKRF_F05142	04 Jan 26	$Y = 1.0021x + 11.273$	0.9995
BKRF_F05143	04 Jan 26	$Y = 1.0023x + 8.3905$	1.0000
BKRF_F05144	04 Jan 26	$Y = 1.0738x + 1.2527$	0.9987
PHK_F050227	10 Jan 24	$Y = 1.1066x + 0.3565$	0.9999
PHK_F050228	10 Jan 24	$Y = 1.053x + 2.52$	1.0000
PHK_F050229	10 Jan 24	$Y = 1.0017x + 8.0124$	1.0000
RYG_F050187	04 Jan 24	$Y = 1.0045x + 10.275$	1.0000
RYG_F050186	04 Jan 24	$Y = 1.0024x + 0.1$	1.0000
RYG_F050189	04 Jan 24	$Y = 1.0343x + 0.3854$	0.9999
RYG_F050654	04 Jan 24	$Y = 1.0529x + 0.1565$	0.9996
RYG_F050655	04 Jan 24	$Y = 0.992x + 8.9667$	0.9992
RYG_F050656	04 Jan 24	$Y = 1.0085x + 2.8429$	1.0000
RYG_F050657	04 Jan 24	$Y = 1.0472x + 1.9228$	0.9999
RYG_F050658	04 Jan 24	$Y = 0.9676x + 20.263$	0.9996
RYG_F050659	04 Jan 24	$Y = 1.0028x + 10.275$	1.0000
SGK_F50135	17 Jan 24	$Y = 1.0145x + 2.8273$	1.0000
SGK_F50136	17 Jan 24	$Y = 1.0113x + 1.75$	0.9999
SGK_F50138	04 Jan 24	$Y = 1.0532x + 1.0034$	0.9999

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ALS Laboratory Group



## ROTA METER CALIBRATION RESULT JANUARY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
SGK_F0139	04 Jan 24	$Y = 1.0047x + 1.8667$	0.9999
SGK_F0140	04 Jan 24	$Y = 1.0003x + 14.149$	1.0000
SGK_F0141	04 Jan 24	$Y = 1.1111x - 1.1337$	0.9994
SGK_F0142	04 Jan 24	$Y = 1.0179x + 0.3693$	0.9999
SGK_F0143	04 Jan 24	$Y = 1.054x + 2.2352$	1.0000

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

Approved By :   
(Mr Sarayuth Jitranont)  
Assistant General Manager



Certificate of System Qualification  
GC-00

System ID: CN11481066  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 154 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.02.02  
Overall Qualification Status: Pass

## CDS Logon Verification - GC

Logon: Sangsathai Tanak  
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:  $\pm 2.0$  and  $\pm 0.5$

Date: April 21, 2023 3:26:38 PM  
System ID: CN11481066

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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:  $\pm 1.2$

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:  $\pm 2.0$  and  $\pm 0.5$

Overall Inlet Pressure Decay Test Status  
Pass

## Inlet Pressure Accuracy

Name: 7890  
Back SSL

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Setpoint Status: Pass  
Inlet Pressure: 25.0 psi Actual: 24.8 psi  
Accuracy: 0.2 psi  
Agilent Recommended:  $\pm 1.2$

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:  $\pm 10.0$  % setpoint (3.0 mL/min)  
Limit is percentage of setpoint or 0.5 mL/min, 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:  $\pm 10.0$  % setpoint (40.0 mL/min)  
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Setpoint Status: Pass  
Flow Type: Makeup  
Setpoint: 25.0 mL/min Measured Flow: 24.9 mL/min  
Accuracy: 0.1 mL/min  
Agilent Recommended:  $\pm 10.0$  % setpoint (2.5 mL/min)  
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

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System ID: CN11481066

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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:  $\pm 10.0$  % setpoint (3.0 mL/min)  
Limit is percentage of setpoint or 0.5 mL/min, 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:  $\pm 10.0$  % setpoint (40.0 mL/min)  
Limit is percentage of setpoint or 0.5 mL/min, 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:  $\pm 10.0$  % setpoint (2.5 mL/min)  
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Overall Detector Flow Accuracy Test Status  
Pass

## GC Oven Temperature Accuracy

Name: 7890

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Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual: 230.0 / 230.6 °C  
Accuracy: 0.6 °C  
Agilent Recommended:  $\pm 1.0$  % setpoint in K (5.0 °C)  
 $\pm 1.0$  % setpoint in K (5.0 °C)

Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual: 100.0 / 100.9 °C  
Accuracy: 0.9 °C  
Agilent Recommended:  $\pm 1.0$  % setpoint in K (3.7 °C)  
 $\pm 1.0$  % 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: 100.0 / 100.8833 °C  
Stability: 0.1 °C  
Agilent Recommended:  $\pm 0.5$

Overall GC Oven Temperature Stability Test Status  
Pass

## Scouting Run

Tested Combination1: Front SSL / Front FID  
Injection Tower: 7890A

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System ID: CN11481066

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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: 0.06 pA  
Agilent Recommended:  $\pm 0.10$  pA  
Status: Pass

Overall Noise and Drift Test Status  
Pass

## Injection Precision

Tested Combination1: Front SSL / Front FID  
Name: 7890A  
Setpoint Status: Pass  
Injection Volume on Column: 1.0 µL  
Area RSD: 0.32 % Retention Time RSD: 0.67 %  
Agilent Recommended:  $\pm 3.00$  %

Overall Injection Precision Test Status  
Pass

## Signal to Noise

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System ID: CN11481066

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Tested Combination1 Front SSL / Front FID

Name: Injection Tower 7890

Setup Status: Pass

Signal to Noise: 721755

Agilent Recommended: 300000

Overall Signal to Noise Test Status: Pass

Scouting Run

Tested Combination2 Back SSL / Back FID

Name: Injection Tower 7890A

Setup Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status: Completed

Noise and Drift

Tested Combination2 Back SSL / Back FID

Name: 7890

Setup Status: Pass

Base Signal: 22.6 uA

ASTM Noise: 0.07 pA

Drift: 0.09 pA/hr

Agilent Recommended: 10.10

Status: Pass

2.50

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Overall Noise and Drift Test Status: Pass

Injection Precision

Tested Combination2 Back SSL / Back FID

Name: 7890A

Setup Status: Pass

Injection Volume on Column: 1.0 uL

Area RSD: 1.28 %

Retention Time RSD: 0.33 %

Agilent Recommended: 3.00

Overall Injection Precision Test Status: Pass

Signal to Noise

Tested Combination2 Back SSL / Back FID

Name: Injection Tower 7890

Setup Status: Pass

Signal to Noise: 2404368

Agilent Recommended: 300000

Overall Signal to Noise Test Status: Pass

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID: CN11481088

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: 7890A

Model Number: G4314A

Serial Number: CN15380030

Firmware Revision: A.11.01

Valve Heater: Not Installed

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Sampler 2

Manufacturer: Agilent Technologies

Type: Injection Tower

Name: 7890A

Model Number: G4313A

Serial Number: CN16280128

Firmware Revision: A.10.09

Usage: Sample Injection

Location: Front

Syringe Volume (uL): 10

Sampler 3

Manufacturer: Agilent Technologies

Type: Injection Tower

Name: 7890A

Model Number: G4313A

Serial Number: CN10340103

Firmware Revision: A.10.09

Usage: Sample Injection

Location: Back

Syringe Volume (uL): 10

Manifold 1

Manufacturer: Agilent Technologies

Name: 7890

Model Number: G3445A

Serial Number: CN11481088

Firmware Revision: Version 4.27

Oven Type: Standard

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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

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Electronic Signature

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Certificate Number
CN-003-68

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**MEASUREMENT RESULTS**

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 3 m/s was calibrated by a standard air velocity transducer and above 3 m/s to 30 m/s was calibrated by a pitot tube with pressure differential pressure meter which was calibrated 40 mm and 300 mm respectively, away from wind tunnel walls. UUC was calibrated at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s in calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

u <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	u <sub>ref</sub> (m/s)	Error (m/s)	U <sub>95</sub> (%)
0.50	23.52	23.50	0.50	-0.2	0.15
1.00	23.48	23.50	1.0	-0.2	0.15
1.50	23.50	23.50	1.5	-0.2	0.17
2.00	23.50	23.50	2.0	-0.2	0.17
2.50	23.50	23.50	2.5	-0.2	0.18
3.00	23.50	23.50	3.0	-0.2	0.17
3.50	23.50	23.50	3.5	-0.2	0.17
4.00	23.50	23.50	4.0	-0.2	0.18
4.50	23.50	23.50	4.5	-0.2	0.18
5.00	23.50	23.50	5.0	-0.2	0.18
5.50	23.50	23.50	5.5	-0.2	0.18
6.00	23.50	23.50	6.0	-0.2	0.18
6.50	23.50	23.50	6.5	-0.2	0.18
7.00	23.50	23.50	7.0	-0.2	0.18
7.50	23.50	23.50	7.5	-0.2	0.18
8.00	23.50	23.50	8.0	-0.2	0.18
8.50	23.50	23.50	8.5	-0.2	0.18
9.00	23.50	23.50	9.0	-0.2	0.18
9.50	23.50	23.50	9.5	-0.2	0.18
10.00	23.50	23.50	10.0	-0.2	0.18
10.50	23.50	23.50	10.5	-0.2	0.18
11.00	23.50	23.50	11.0	-0.2	0.18
11.50	23.50	23.50	11.5	-0.2	0.18
12.00	23.50	23.50	12.0	-0.2	0.18
12.50	23.50	23.50	12.5	-0.2	0.18
13.00	23.50	23.50	13.0	-0.2	0.18
13.50	23.50	23.50	13.5	-0.2	0.18
14.00	23.50	23.50	14.0	-0.2	0.18
14.50	23.50	23.50	14.5	-0.2	0.18
15.00	23.50	23.50	15.0	-0.2	0.18
15.50	23.50	23.50	15.5	-0.2	0.18

**Remarks:**  
Calibration results only valid for the tested circumstances and environmental conditions during which calibration test plate.

\* Validity of standard  
\* Validity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**

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

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CN-027-68

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**MEASUREMENT RESULTS**

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 3 m/s was calibrated by a standard air velocity transducer and above 3 m/s to 30 m/s was calibrated by a pitot tube with pressure differential pressure meter which was calibrated 40 mm and 300 mm respectively, away from wind tunnel walls. UUC was calibrated at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s in calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

u <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	u <sub>ref</sub> (m/s)	Error (m/s)	U <sub>95</sub> (%)
0.50	23.52	23.50	0.50	-0.2	0.15
1.00	23.48	23.50	1.0	-0.2	0.15
1.50	23.50	23.50	1.5	-0.2	0.17
2.00	23.50	23.50	2.0	-0.2	0.17
2.50	23.50	23.50	2.5	-0.2	0.18
3.00	23.50	23.50	3.0	-0.2	0.17
3.50	23.50	23.50	3.5	-0.2	0.17
4.00	23.50	23.50	4.0	-0.2	0.18
4.50	23.50	23.50	4.5	-0.2	0.18
5.00	23.50	23.50	5.0	-0.2	0.18
5.50	23.50	23.50	5.5	-0.2	0.18
6.00	23.50	23.50	6.0	-0.2	0.18
6.50	23.50	23.50	6.5	-0.2	0.18
7.00	23.50	23.50	7.0	-0.2	0.18
7.50	23.50	23.50	7.5	-0.2	0.18
8.00	23.50	23.50	8.0	-0.2	0.18
8.50	23.50	23.50	8.5	-0.2	0.18
9.00	23.50	23.50	9.0	-0.2	0.18
9.50	23.50	23.50	9.5	-0.2	0.18
10.00	23.50	23.50	10.0	-0.2	0.18
10.50	23.50	23.50	10.5	-0.2	0.18
11.00	23.50	23.50	11.0	-0.2	0.18
11.50	23.50	23.50	11.5	-0.2	0.18
12.00	23.50	23.50	12.0	-0.2	0.18
12.50	23.50	23.50	12.5	-0.2	0.18
13.00	23.50	23.50	13.0	-0.2	0.18
13.50	23.50	23.50	13.5	-0.2	0.18
14.00	23.50	23.50	14.0	-0.2	0.18
14.50	23.50	23.50	14.5	-0.2	0.18
15.00	23.50	23.50	15.0	-0.2	0.18
15.50	23.50	23.50	15.5	-0.2	0.18

**Remarks:**  
Calibration results only valid for the tested circumstances and environmental conditions during which calibration test plate.

\* Validity of standard  
\* Validity of Unit Under Calibration

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Certificate Number
CN-001-68

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**MEASUREMENT RESULTS**

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 3 m/s was calibrated by a standard air velocity transducer and above 3 m/s to 30 m/s was calibrated by a pitot tube with pressure differential pressure meter which was calibrated 40 mm and 300 mm respectively, away from wind tunnel walls. UUC was calibrated at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s in calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

u <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	u <sub>ref</sub> (m/s)	Error (m/s)	U <sub>95</sub> (%)
0.50	23.52	23.50	0.50	-0.2	0.15
1.00	23.48	23.50	1.0	-0.2	0.15
1.50	23.50	23.50	1.5	-0.2	0.17
2.00	23.50	23.50	2.0	-0.2	0.17
2.50	23.50	23.50	2.5	-0.2	0.18
3.00	23.50	23.50	3.0	-0.2	0.17
3.50	23.50	23.50	3.5	-0.2	0.17
4.00	23.50	23.50	4.0	-0.2	0.18
4.50	23.50	23.50	4.5	-0.2	0.18
5.00	23.50	23.50	5.0	-0.2	0.18
5.50	23.50	23.50	5.5	-0.2	0.18
6.00	23.50	23.50	6.0	-0.2	0.18
6.50	23.50	23.50	6.5	-0.2	0.18
7.00	23.50	23.50	7.0	-0.2	0.18
7.50	23.50	23.50	7.5	-0.2	0.18
8.00	23.50	23.50	8.0	-0.2	0.18
8.50	23.50	23.50	8.5	-0.2	0.18
9.00	23.50	23.50	9.0	-0.2	0.18
9.50	23.50	23.50	9.5	-0.2	0.18
10.00	23.50	23.50	10.0	-0.2	0.18
10.50	23.50	23.50	10.5	-0.2	0.18
11.00	23.50	23.50	11.0	-0.2	0.18
11.50	23.50	23.50	11.5	-0.2	0.18
12.00	23.50	23.50	12.0	-0.2	0.18
12.50	23.50	23.50	12.5	-0.2	0.18
13.00	23.50	23.50	13.0	-0.2	0.18
13.50	23.50	23.50	13.5	-0.2	0.18
14.00	23.50	23.50	14.0	-0.2	0.18
14.50	23.50	23.50	14.5	-0.2	0.18
15.00	23.50	23.50	15.0	-0.2	0.18
15.50	23.50	23.50	15.5	-0.2	0.18

**Remarks:**  
Calibration results only valid for the tested circumstances and environmental conditions during which calibration test plate.

\* Validity of standard  
\* Validity of Unit Under Calibration

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Certificate Number
CN-001-68

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**MEASUREMENT RESULTS**

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 3 m/s was calibrated by a standard air velocity transducer and above 3 m/s to 30 m/s was calibrated by a pitot tube with pressure differential pressure meter which was calibrated 40 mm and 300 mm respectively, away from wind tunnel walls. UUC was calibrated at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s in calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

u <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	u <sub>ref</sub> (m/s)	Error (m/s)	U <sub>95</sub> (%)
0.50	23.52	23.50	0.50	-0.2	0.15
1.00	23.48	23.50	1.0	-0.2	0.15
1.50	23.50	23.50	1.5	-0.2	0.17
2.00	23.50	23.50	2.0	-0.2	0.17
2.50	23.50	23.50	2.5	-0.2	0.18
3.00	23.50	23.50	3.0	-0.2	0.17
3.50	23.50	23.50	3.5	-0.2	0.17
4.00	23.50	23.50	4.0	-0.2	0.18
4.50	23.50	23.50	4.5	-0.2	0.18
5.00	23.50	23.50	5.0	-0.2	0.18
5.50	23.50	23.50	5.5	-0.2	0.18
6.00	23.50	23.50	6.0	-0.2	0.18
6.50	23.50	23.50	6.5	-0.2	0.18
7.00	23.50	23.50	7.0	-0.2	0.18
7.50	23.50	23.50	7.5	-0.2	0.18
8.00	23.50	23.50	8.0	-0.2	0.18
8.50	23.50	23.50	8.5	-0.2	0.18
9.00	23.50	23.50	9.0	-0.2	0.18
9.50	23.50	23.50	9.5	-0.2	0.18
10.00	23.50	23.50	10.0	-0.2	0.18
10.50	23.50	23.50	10.5	-0.2	0.18
11.00	23.50	23.50	11.0	-0.2	0.18
11.50	23.50	23.50	11.5	-0.2	0.18
12.00	23.50	23.50	12.0	-0.2	0.18
12.50	23.50	23.50	12.5	-0.2	0.18
13.00	23.50	23.50	13.0	-0.2	0.18
13.50	23.50	23.50	13.5	-0.2	0.18
14.00	23.50	23.50	14.0	-0.2	0.18
14.50	23.50	23.50	14.5	-0.2	0.18
15.00	23.50	23.50	15.0	-0.2	0.18
15.50	23.50	23.50	15.5	-0.2	0.18

**Remarks:**  
Calibration results only valid for the tested circumstances and environmental conditions during which calibration test plate.

\* Validity of standard  
\* Validity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**

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

Certificate Number
CN-003-68

Page 2 of 2 Pages

**MEASUREMENT RESULTS**

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 (Locally 3 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	θ <sub>ref</sub> Degree (°)	θ <sub>meas</sub> Degree (°)	Error Degree (°)	U <sub>95</sub> (%)
4.38	0.00	0	0	0.00
	45.00	45	-4	0.04
	90.00	87	-3	0.04
	135.00	132	-3	0.10
	180.00	178	-2	0.10
	225.00	222	-3	0.10
	270.00	274	4	0.10
	315.00	320	5	0.10

**Remarks:**  
\* Calibration results only valid for the tested circumstances and environmental conditions during which calibration test plate.

\* Validity of standard  
\* Validity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**

Calibration set-up of the wind direction sensor in the wind tunnel of Jiranatee Associates Co., Ltd. The wind direction sensor shown may differ from the calibrated one. Remarks: The position of the set-up is not to scale due to image geometry.

Certificate Number
CN-001-68

Page 1 of 2 Pages

**MEASUREMENT RESULTS**

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 (Locally 3 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	θ <sub>ref</sub> Degree (°)	θ <sub>meas</sub> Degree (°)	Error Degree (°)	U <sub>95</sub> (%)
4.38	0.00	0	0	0.00
	45.00	45	-4	0.04
	90.00	87	-3	0.04
	135.00	132	-3	0.10
	180.00	178	-2	0.10
	225.00	222	-3	0.10
	270.00	274	4	0.10
	315.00	320	5	0.10

**Remarks:**  
Calibration results only valid for the tested circumstances and environmental conditions during which calibration test plate.

\* Validity of standard  
\* Validity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**

Calibration set-up of the wind direction sensor in the wind tunnel of Jiranatee Associates Co., Ltd. The wind direction sensor shown may differ from the calibrated one. Remarks: The position of the set-up is not to scale due to image geometry.

Page 2 of 3 Pages

MEASUREMENT RESULTS<sup>1</sup>

The wind direction sensor was calibrated against standard rotary vane sensor by comparison method. During calibration, the measurement was carried out at 40° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (about 1 m/s) is kept constant while the error is varied around the vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed	D <sub>90</sub>	D <sub>10</sub>	Error	U(D <sub>90</sub> )
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
1.00	40.000	41	-1	0.9
	90.000	87	-3	1.0
	135.000	133	-3	0.9
	180.000	180	0	1.0
	225.000	226	1	1.0
	270.000	271	0	1.0
3.00	225.000	226	1	1.0
	270.000	271	0	1.0

Remarks:

<sup>1</sup> Calibration results only valid for the tested circumstances and environmental conditions during which calibration was performed.

Signature of customer

Signature of Unit Under Calibration

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

J NAC  
JIRANATEE ASSOCIATES CO., LTD.

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CERTIFICATE OF CALIBRATION

Calibration No.: JCI-037-002  
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger

Manufacturer: Honeywell

Model/Type: HI-WS-250L-D

Serial Number: A5662

ID No.: R10\_F00544

Customer: A/S Laboratory group (Thailand) Co., Ltd.  
104 Phatthanaburi 40, Phatthanaburi 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±1)%.  
Measurement Method:  
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1840-3 in the humidity generator chamber to determine the errors.

Traceability:  
The 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 NAC Calibration, Inc. Certificate number: 20909-001, Due date: May 26, 2024.

Measurement Date: 14.01.2023  
Issued Date: 14.01.2023

Measurement Results:  
This equipment was connected with indoor air quality probe and Displayed RH on display. Model: HMP90, Serial number: T3320581.  
Calibration was performed in the range of 20%RH to 80%RH.  
The results of calibration are reported in table below.

Calibrated	Standard setting	UUC device	Error	Uncertainty
(%RH)	(%RH)	(%RH)	(%RH)	(%RH)
20	20.07	16.3	-3.8	0.91
50	50.23	48.0	-2.2	0.91
80	80.23	73.5	-6.7	0.91

Performed by:  
☐ Mr. Somrat Thachalad  
☒ Miss Jitraporn Lertwongthai  
☐ Miss Thungrungrat Phoommit

Approved Signature: Mr. Pinyap Booncharoen  
Calibration Department Manager

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Wathapa, Bangkok 10600 Thailand.  
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CERTIFICATE OF CALIBRATION

Calibration No.: JCI-037-006  
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novamys

Model: 110-WS-250L-D

Serial No: A5662

ID No: R10\_F00544

Customer:  
Name: A/S Laboratory group (Thailand) Co., Ltd.  
Address: 104 Phatthanaburi 40, Phatthanaburi Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

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

Reference Used During Calibration:  
1. Standard Temperature Probe Model: ITS-100 AS01, Serial No: 667882-09, Due date: 28 Mar 2024  
2. Digital Temperature Indicator Model: DT-1000-A MR, Serial No: 673407-00091, Due date: 22 July 2023

Calibration Condition:  
Temperature: (23±0.1)°C  
Relative Humidity: (55±1)5%

Traceability:  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology (NIMT) Certificate number: TT-0038-23, Certificate number: 09-0092-22

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

Traceability:  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology (NIMT) Certificate number: TT-0038-23, Certificate number: 09-0092-22

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

Calibrated by:  
☐ Mr. Somrat Thachalad  
☒ Miss Jitraporn Lertwongthai  
☐ Miss Thungrungrat Phoommit

Approved Signature: Mr. Pinyap Booncharoen  
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Calibration No.: JCI-037-007  
Page 1 of 2 Pages

Measurement Item: Relative humidity with data logger

Manufacturer: Honeywell

Model/Type: HI-WS-250L-D

Serial Number: A5662

ID No.: R10\_F00544

Customer: A/S Laboratory group (Thailand) Co., Ltd.  
104 Phatthanaburi 40, Phatthanaburi 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±1)%.  
Measurement Method:  
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1840-3 in the humidity generator chamber to determine the errors.

Traceability:  
The 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 NAC Calibration, Inc. Certificate number: 20909-001, Due date: May 26, 2024.

Measurement Date: 14.01.2023  
Issued Date: 14.01.2023

Measurement Results:  
This equipment was connected with indoor air quality probe and Displayed RH on display. Model: HMP90, Serial number: T3320581.  
Calibration was performed in the range of 20%RH to 80%RH.  
The results of calibration are reported in table below.

Calibrated	Standard setting	UUC device	Error	Uncertainty
(%RH)	(%RH)	(%RH)	(%RH)	(%RH)
20	20.07	16.3	-3.8	0.91
50	50.23	48.0	-2.2	0.91
80	80.23	73.5	-6.7	0.91

Performed by:  
☐ Mr. Somrat Thachalad  
☒ Miss Jitraporn Lertwongthai  
☐ Miss Thungrungrat Phoommit

Approved Signature: Mr. Pinyap Booncharoen  
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Calibration No.: JCI-037-008  
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: HMP90 S/N: T3320581.  
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	29.060	19.8	-9.3	0.099
70	29.054	24.6	-4.5	0.099
70	30.000	29.7	-0.3	0.14
70	35.043	34.5	-0.5	0.099
70	40.038	39.5	-0.5	0.14

UUC<sup>1</sup>: 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\*\*\*

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JIRANATEE ASSOCIATES CO., LTD.

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Wathapa, Bangkok 10600 Thailand.  
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CERTIFICATE OF CALIBRATION

Calibration No.: JCI-037-009  
Page 1 of 2 Pages

Measurement Results<sup>1</sup>

The cup anemometer, Unit Under Calibration (UUC) was operated at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 10 m/s was calculated by a standard air velocity transducer and above 3 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 80 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 15 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

u <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	u <sub>ref</sub> (m/s)	Error (m/s)	U(u <sub>ref</sub> ) (m/s)
1.000	24.30	24.30	0.9	-0.1	0.01
2.000	24.54	24.30	1.9	-0.2	0.01
3.000	24.68	24.30	2.9	-0.1	0.01
4.000	24.64	24.30	4.0	-0.3	0.01
5.000	25.39	24.30	4.9	-0.1	0.01
5.997	25.63	24.30	5.9	-0.1	0.01
7.001	25.78	24.30	6.9	-0.1	0.01
8.000	26.00	24.30	8.0	-0.3	0.01
9.000	26.62	24.30	9.0	-0.6	0.01
10.000	27.39	24.30	9.9	-0.1	0.01
11.000	28.84	24.30	11.1	0.0	0.01
12.000	29.80	24.30	12.0	0.0	0.01
13.000	30.62	24.30	13.0	0.0	0.01
14.000	31.74	24.30	14.0	-0.1	0.01
15.000	33.00	24.30	15.0	0.0	0.01
16.000	33.24	24.30	16.1	-0.1	0.01

Remarks:

<sup>1</sup> Calibration results only valid for the tested circumstances and environmental conditions during which calibration was performed.

<sup>2</sup> Uncertainty of standard

<sup>3</sup> Uncertainty of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP

Calibration setup of the cup anemometer calibrated to the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remarks: The properties of the air, as it is not true air, are displayed approximately.

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

J NAC  
JIRANATEE ASSOCIATES CO., LTD.

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

<b>MEASUREMENT ITEM</b>	Wind direction sensor	<b>Collector procedure</b>
<b>MANUFACTURER</b>	Hemisphere	The wind direction sensor was calibrated against standard Rotary Encoder, model AS8000-01, 2048 PLS in an air flow tunnel, of 200 mm diameter, with 300 mm² flow area. The test is done in accordance with ISO 9126-12-2, Part 12.2.2. The test is done in accordance with ISO 9126-12-2, Part 12.2.2. The test is done in accordance with ISO 9126-12-2, Part 12.2.2.
<b>SERIAL NUMBER</b>	300-WS-2518	
<b>IS NUMBER</b>	AS8000-01	
<b>CONDITION AS RECEIVED</b>	Used item	
<b>CUSTOMER</b>	ACS Laboratory group (Thailand) Co., Ltd. 100/41, 42/25-10, Ponchanon 1-10, 84, 84/10, Bangkok 10110, Thailand.	
<b>RECEIVED DATE</b>	13 Aug 2023	
<b>MEASUREMENT DATE</b>	18 Aug 2023	
<b>ISSUE DATE</b>	23 Aug 2023	
<b>ENVIRONMENTAL CONDITIONS</b>	Ambient condition in the laboratory are as follows: Temperature: 23.0 ± 0.5 °C Relative Humidity: 55.0 ± 0.5 %RH Atmospheric Pressure: 1020.10 hPa	
<b>PLACE OF CALIBRATION</b>	Effect type wind tunnel of Jiranatee Associates Co., Ltd.	
<b>CALIBRATION CONDITION</b>	Wind tunnel cross section area: 900 cm² Wind direction frontal area: 120 cm² Diameter of rotating pipe: 100 mm Blockage ratio of wind tunnel: 0.143	
<b>Preconditioning</b>	24 hours at ambient conditions.	
<b>Measurement Condition</b>	The average values during measurement are 23.0°C, 55.0% RH and 1020.1 hPa.	

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

Calibrated by:  
[2] Mr. Somsak Thiboonan  
[3] Miss Jiraporn Jiraporn

Approved signature: Mr. Panyaporn Boonchuan  
Calibration Department Manager

**Remarks:**  
\*Following calibration area of the wind tunnel  
\*Following cross section area of the wind tunnel include mounting plate  
\*Example of mounting plate  
\*Note: See

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Air speed	D <sub>ref</sub>	D <sub>meas</sub>	Error	U <sub>95%</sub>
m/s	Degrees (°)	Degrees (°)	Degrees (°)	Degrees (°)
4.0	41	-4	-0.4	0.1
5.0	41	-4	-0.4	0.1
6.0	41	-4	-0.4	0.1
7.0	41	-4	-0.4	0.1
8.0	41	-4	-0.4	0.1
9.0	41	-4	-0.4	0.1
10.0	41	-4	-0.4	0.1
11.0	41	-4	-0.4	0.1
12.0	41	-4	-0.4	0.1
13.0	41	-4	-0.4	0.1
14.0	41	-4	-0.4	0.1
15.0	41	-4	-0.4	0.1
16.0	41	-4	-0.4	0.1
17.0	41	-4	-0.4	0.1
18.0	41	-4	-0.4	0.1
19.0	41	-4	-0.4	0.1
20.0	41	-4	-0.4	0.1
21.0	41	-4	-0.4	0.1
22.0	41	-4	-0.4	0.1
23.0	41	-4	-0.4	0.1
24.0	41	-4	-0.4	0.1
25.0	41	-4	-0.4	0.1
26.0	41	-4	-0.4	0.1
27.0	41	-4	-0.4	0.1
28.0	41	-4	-0.4	0.1
29.0	41	-4	-0.4	0.1
30.0	41	-4	-0.4	0.1
31.0	41	-4	-0.4	0.1
32.0	41	-4	-0.4	0.1
33.0	41	-4	-0.4	0.1
34.0	41	-4	-0.4	0.1
35.0	41	-4	-0.4	0.1
36.0	41	-4	-0.4	0.1
37.0	41	-4	-0.4	0.1
38.0	41	-4	-0.4	0.1
39.0	41	-4	-0.4	0.1
40.0	41	-4	-0.4	0.1

**Remarks:**  
\*Calibration results only valid for the stated circumstances and environmental conditions during which calibration was performed.  
\*Uncertainty of wind direction  
\*Uncertainty of wind direction calibration

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

Calibrated by:  
[2] Mr. Somsak Thiboonan  
[3] Miss Jiraporn Jiraporn

Approved signature: Mr. Panyaporn Boonchuan  
Calibration Department Manager

**Remarks:**  
\*Following calibration area of the wind tunnel  
\*Following cross section area of the wind tunnel include mounting plate  
\*Example of mounting plate  
\*Note: See

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## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

<b>MEASUREMENT ITEM</b>	Wind direction sensor	<b>Collector procedure</b>
<b>MANUFACTURER</b>	Hemisphere	The wind direction sensor was calibrated against standard Rotary Encoder, model AS8000-01, 2048 PLS in an air flow tunnel, of 200 mm diameter, with 300 mm² flow area. The test is done in accordance with ISO 9126-12-2, Part 12.2.2. The test is done in accordance with ISO 9126-12-2, Part 12.2.2. The test is done in accordance with ISO 9126-12-2, Part 12.2.2.
<b>SERIAL NUMBER</b>	300-WS-2518	
<b>IS NUMBER</b>	AS8000-01	
<b>CONDITION AS RECEIVED</b>	Used item	
<b>CUSTOMER</b>	ACS Laboratory group (Thailand) Co., Ltd. 100/41, 42/25-10, Ponchanon 1-10, 84, 84/10, Bangkok 10110, Thailand.	
<b>RECEIVED DATE</b>	13 Aug 2023	
<b>MEASUREMENT DATE</b>	18 Aug 2023	
<b>ISSUE DATE</b>	23 Aug 2023	
<b>ENVIRONMENTAL CONDITIONS</b>	Ambient condition in the laboratory are as follows: Temperature: 23.0 ± 0.5 °C Relative Humidity: 55.0 ± 0.5 %RH Atmospheric Pressure: 1020.10 hPa	
<b>PLACE OF CALIBRATION</b>	Effect type wind tunnel of Jiranatee Associates Co., Ltd.	
<b>CALIBRATION CONDITION</b>	Wind tunnel cross section area: 900 cm² Wind direction frontal area: 120 cm² Diameter of rotating pipe: 100 mm Blockage ratio of wind tunnel: 0.143	
<b>Preconditioning</b>	24 hours at ambient conditions.	
<b>Measurement Condition</b>	The average values during measurement are 23.0°C, 55.0% RH and 1020.1 hPa.	

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

Calibrated by:  
[2] Mr. Somsak Thiboonan  
[3] Miss Jiraporn Jiraporn

Approved signature: Mr. Panyaporn Boonchuan  
Calibration Department Manager

**Remarks:**  
\*Following calibration area of the wind tunnel  
\*Following cross section area of the wind tunnel include mounting plate  
\*Example of mounting plate  
\*Note: See

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Air speed	D <sub>ref</sub>	D <sub>meas</sub>	Error	U <sub>95%</sub>
m/s	Degrees (°)	Degrees (°)	Degrees (°)	Degrees (°)
4.0	41	-4	-0.4	0.1
5.0	41	-4	-0.4	0.1
6.0	41	-4	-0.4	0.1
7.0	41	-4	-0.4	0.1
8.0	41	-4	-0.4	0.1
9.0	41	-4	-0.4	0.1
10.0	41	-4	-0.4	0.1
11.0	41	-4	-0.4	0.1
12.0	41	-4	-0.4	0.1
13.0	41	-4	-0.4	0.1
14.0	41	-4	-0.4	0.1
15.0	41	-4	-0.4	0.1
16.0	41	-4	-0.4	0.1
17.0	41	-4	-0.4	0.1
18.0	41	-4	-0.4	0.1
19.0	41	-4	-0.4	0.1
20.0	41	-4	-0.4	0.1
21.0	41	-4	-0.4	0.1
22.0	41	-4	-0.4	0.1
23.0	41	-4	-0.4	0.1
24.0	41	-4	-0.4	0.1
25.0	41	-4	-0.4	0.1
26.0	41	-4	-0.4	0.1
27.0	41	-4	-0.4	0.1
28.0	41	-4	-0.4	0.1
29.0	41	-4	-0.4	0.1
30.0	41	-4	-0.4	0.1
31.0	41	-4	-0.4	0.1
32.0	41	-4	-0.4	0.1
33.0	41	-4	-0.4	0.1
34.0	41	-4	-0.4	0.1
35.0	41	-4	-0.4	0.1
36.0	41	-4	-0.4	0.1
37.0	41	-4	-0.4	0.1
38.0	41	-4	-0.4	0.1
39.0	41	-4	-0.4	0.1
40.0	41	-4	-0.4	0.1

**Remarks:**  
\*Calibration results only valid for the stated circumstances and environmental conditions during which calibration was performed.  
\*Uncertainty of wind direction  
\*Uncertainty of wind direction calibration

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

Calibrated by:  
[2] Mr. Somsak Thiboonan  
[3] Miss Jiraporn Jiraporn

Approved signature: Mr. Panyaporn Boonchuan  
Calibration Department Manager

**Remarks:**  
\*Following calibration area of the wind tunnel  
\*Following cross section area of the wind tunnel include mounting plate  
\*Example of mounting plate  
\*Note: See

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## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

<b>MEASUREMENT ITEM</b>	Cup anemometer	<b>Collector procedure</b>
<b>MANUFACTURER</b>	Hemisphere	The cup anemometer was calibrated against standard velocity transducer, model AS8000-01, 2048 PLS in an air flow tunnel, of 200 mm diameter, with 300 mm² flow area. The test is done in accordance with ISO 9126-12-2, Part 12.2.2. The test is done in accordance with ISO 9126-12-2, Part 12.2.2. The test is done in accordance with ISO 9126-12-2, Part 12.2.2.
<b>SERIAL NUMBER</b>	300-WS-2518	
<b>IS NUMBER</b>	AS8000-01	
<b>CONDITION AS RECEIVED</b>	Used item	
<b>CUSTOMER</b>	ACS Laboratory group (Thailand) Co., Ltd. 100/41, 42/25-10, Ponchanon 1-10, 84, 84/10, Bangkok 10110, Thailand.	
<b>RECEIVED DATE</b>	13 Aug 2023	
<b>MEASUREMENT DATE</b>	18 Aug 2023	
<b>ISSUE DATE</b>	23 Aug 2023	
<b>ENVIRONMENTAL CONDITIONS</b>	Ambient condition in the laboratory are as follows: Temperature: 23.0 ± 0.5 °C Relative Humidity: 55.0 ± 0.5 %RH Atmospheric Pressure: 1020.10 hPa	
<b>PLACE OF CALIBRATION</b>	Effect type wind tunnel of Jiranatee Associates Co., Ltd.	
<b>CALIBRATION CONDITION</b>	Wind tunnel cross section area: 900 cm² Wind direction frontal area: 120 cm² Diameter of rotating pipe: 100 mm Blockage ratio of wind tunnel: 0.143	
<b>Preconditioning</b>	24 hours at ambient conditions.	









63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,  
Walthapa, Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.com

## CERTIFICATE OF CALIBRATION

Calibration No.: JIR-01072023  
Page 1 of 1 Page

Measurement Item: Relative humidity with data logger  
Manufacturer: HANNA  
Model/Type: HI-WS-250L-0  
Serial Number: A5500  
ID No.: RWS\_F00544  
Customer: A.S. Laboratory group (Thailand) Co., Ltd.  
Address: 104 Phraetham 40, Phraetham Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:  
The measurement was carried out in an ambient temperature of 25±0.5°C, and relative humidity of 50±1.5%.

Measurement Method:  
Unit Under Calibration (UUC) was stabilized by comparison method with standard digital hygrometer model 1840-3 in the humidity generator chamber to determine the error.

Traceability:  
This instrument was calibrated using standard equipment whose accuracy is traceable through National Institute of Standards and Technology to the international system of units (SI) via NIST Calibration, Inc. Certificate number: 20929-001, Due date Sep 26, 2024.

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

Measurement Result:  
This equipment was connected with indoor air quality probe and Displayed RH% on display. Model: HANNA, Serial number: T23020501.

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

Calibration	Standard setting	UUC display	Error	Uncertainty
(RH%)	(RH%)	(RH%)	(RH%)	(RH%)
20	20.07	16.9	-3.8	0.51
50	50.25	48.0	-2.3	0.51
80	80.23	73.5	-6.7	0.51

Performed by:  
☒ Mr. Sarawat Thachai  
☒ Miss Jiraporn Lertkarnkarn  
☒ Miss Ruangsarn Phoommit



Approved Signature: Mr. Pinyas Boonchuan  
Calibration Department Manager

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Accredited calibration laboratory  
JIR-01072023  
NIST-01072023  
CALIBRATION 087

Air speed measurement laboratory  
Calibration services department

Page 1 of 2 Pages

## CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM: Cup anemometer  
Manufacturer: HANNA  
Model/Type: HI-WS-250L-0  
Serial Number: A5500  
ID No.: RWS\_F00544  
Customer: A.S. Laboratory group (Thailand) Co., Ltd.  
Address: 104 Phraetham 40, Phraetham Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE: 16 Jun 2023  
MEASUREMENT DATE: 16 Jun 2023  
ISSUE DATE: 16 Jun 2023

ENVIRONMENTAL CONDITIONS:  
Ambient condition in the laboratory are as follows:  
Temperature: 25.0 ± 0.5 °C  
Relative Humidity: 50.0 ± 1.5 %  
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION: 17th floor wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS:  
Wind speed: 0.50 m/s  
Wind direction: 0°  
Diameter of rotating cup: 0.111 m

Preconditioning:  
Measurement Condition: 24 hours at ambient conditions.  
The average values during measurement are (24.4) °C, (41.8) RH% and (1011.5) hPa.

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

Calibrated by:  
☒ Mr. Sarawat Thachai  
☒ Miss Jiraporn Lertkarnkarn



Approved Signature: Mr. Pinyas Boonchuan  
Calibration Department Manager

Remarks:  
1. Uncertainty of measurement is 0.51 m/s.  
2. Uncertainty of measurement is 0.51 m/s.  
3. Uncertainty of measurement is 0.51 m/s.

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Certificate Number:  
C3-025-06

Page 2 of 2 Pages

MEASUREMENT RESULTS:  
The wind direction sensor was calibrated against standard rotary anemometer by comparison method. During calibration, the measurement was carried out at 40° intervals in clockwise and counter-clockwise directions after adjustment has been made. The flow speed of wind tunnel (usually 1 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	°C	°F	Error	°C
m/s	Degrees	Degrees	Degrees	Degrees
0.00	0	0	0	0
0.50	41	106	-3	106
1.00	87	189	-3	189
1.50	133	271	-2	271
2.00	180	356	1	356
2.50	226	435	1	435
3.00	272	519	2	519
3.50	318	604	1	604

Remarks:  
1. Calibration results only valid for the listed conditions and environmental conditions during which calibration was performed.  
2. Uncertainty of measurement is 0.51 m/s.  
3. Uncertainty of measurement is 0.51 m/s.

Traceability:  
The measurement is traceable to the international system of units (SI) through the National Institute of Standards and Technology (NIST) via NIST Calibration, Inc. Certificate number: 20929-001, Due date Sep 26, 2024.

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

Calibration Procedure:  
The wind direction sensor was calibrated against standard rotary anemometer by comparison method. During calibration, the measurement was carried out at 40° intervals in clockwise and counter-clockwise directions after adjustment has been made. The flow speed of wind tunnel (usually 1 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.

Calibration Condition:  
Temperature: 25.0 ± 0.5 °C  
Relative Humidity: 50.0 ± 1.5 %  
Atmospheric Pressure: 1010 ± 10 hPa

Calibration Date: 16 Jun 2023  
Issue Date: 16 Jun 2023

ENVIRONMENTAL CONDITIONS:  
Ambient condition in the laboratory are as follows:  
Temperature: 25.0 ± 0.5 °C  
Relative Humidity: 50.0 ± 1.5 %  
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION: 17th floor wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS:  
Wind speed: 0.50 m/s  
Wind direction: 0°  
Diameter of rotating cup: 0.111 m

Preconditioning:  
Measurement Condition: 24 hours at ambient conditions.  
The average values during measurement are (24.4) °C, (41.8) RH% and (1011.5) hPa.

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

Calibrated by:  
☒ Mr. Sarawat Thachai  
☒ Miss Jiraporn Lertkarnkarn

Approved Signature: Mr. Pinyas Boonchuan  
Calibration Department Manager

Remarks:  
1. Uncertainty of measurement is 0.51 m/s.  
2. Uncertainty of measurement is 0.51 m/s.  
3. Uncertainty of measurement is 0.51 m/s.

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Certificate Number:  
C3-025-06

Page 2 of 2 Pages

MEASUREMENT RESULTS:  
The cup anemometer, Unit Under Calibration (UUC) was measured at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 3 m/s was calculated by a standard air velocity transducer and above 3 m/s to 10 m/s was calculated by a pitot tube with pressure differential pressure meter which was installed at 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 10 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. section	UUC	Error	U-unc
m/s	°C	°C	m/s	m/s	m/s
1.00	24.40	24.40	0.9	-0.1	0.51
1.50	24.50	24.50	1.4	-0.1	0.51
2.00	24.40	24.40	2.0	-0.1	0.51
2.50	24.24	24.40	2.6	-0.1	0.51
3.00	24.50	24.40	3.3	-0.1	0.51
3.50	24.50	24.40	4.0	-0.1	0.51
4.00	24.50	24.40	4.7	-0.1	0.51
4.50	24.50	24.40	5.4	-0.1	0.51
5.00	24.50	24.40	6.1	-0.1	0.51
5.50	24.50	24.40	6.8	-0.1	0.51
6.00	24.50	24.40	7.5	-0.1	0.51
6.50	24.50	24.40	8.2	-0.1	0.51
7.00	24.50	24.40	8.9	-0.1	0.51
7.50	24.50	24.40	9.6	-0.1	0.51
8.00	24.50	24.40	10.3	-0.1	0.51
8.50	24.50	24.40	11.0	-0.1	0.51
9.00	24.50	24.40	11.7	-0.1	0.51
9.50	24.50	24.40	12.4	-0.1	0.51
10.00	24.50	24.40	13.1	-0.1	0.51

Remarks:  
1. Calibration results only valid for the listed conditions and environmental conditions during which calibration was performed.  
2. Uncertainty of measurement is 0.51 m/s.  
3. Uncertainty of measurement is 0.51 m/s.

PHOTO OF CALIBRATION SET-UP



Calibration setup of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shows may differ from the laboratory one. Remarks: The proportion of the set-up is not true to scale.

Calibration Date: 16 Jun 2023  
Issue Date: 16 Jun 2023

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## CERTIFICATE OF CALIBRATION

Certificate No.: C3-025-06  
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor  
Manufacturer: HANNA  
Model: HI-WS-250L-0  
Serial No.: A5500  
ID No.: RWS\_F00544

Customer:  
Name: A.S. Laboratory group (Thailand) Co., Ltd.  
Address: 104 Phraetham 40, Phraetham 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.: 667982-09, Due date: 28 Mar 2024  
2. Digital Temperature Indicator Model: DT-1000-A MK II, Serial No.: 671467-05591 Due date: 22 July 2023

Calibration Condition:  
Temperature: 23±0.5 °C  
Relative Humidity: 50±1.5%

Calibration Procedure:  
The temperature calibration was done by in-house calibration method as per ISO-9001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

Traceability:  
The measurement is traceable to the international system of units (SI) through the National Institute of Standards and Technology (NIST) via NIST Calibration, Inc. Certificate number: 20929-001, Due date Sep 26, 2024.

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

Calibrated by:  
☒ Mr. Sarawat Thachai  
☒ Miss Jiraporn Lertkarnkarn  
☒ Miss Ruangsarn Phoommit



Approved Signature: Mr. Pinyas Boonchuan  
Calibration Department Manager

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

Function: This equipment was connected with temperature sensor Model HM90 S/N: V1902214.

Dimension: Diameter 12 mm, Length 90 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.067	20.0	-0.1	0.099
70	25.051	24.9	-0.2	0.099
70	30.044	29.8	-0.2	0.099
70	35.039	34.8	-0.2	0.099
70	40.034	39.7	-0.3	0.099

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

\* End of Certificate \*



## CERTIFICATE OF CALIBRATION

Certificate No.: JH-09030202  
Page 1 of 1 Page

Measurement Item: Relative humidity with data logger  
Manufacturer: Novapine  
Model/Type: I 10 WS 250L-E  
Serial Number: A5990  
ID No.: PNO/70049  
Customer: A.S. Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition: The measurement was carried out in an ambient temperature of (25±0.2)°C and relative humidity of (50±10)%.

Measurement Method: Unit Under Calibration (UUC) was calibrated by comparison method with standard utilized master hygrometer model: 1860-2 in the humidity generator chamber to determine the error.

Traceability: This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) by MCS Calibration, Inc. Certificate number: 20020-001. Due date: Sep 24, 2024.

Measurement Date: Jun 20, 2023  
Issued Date: Jun 22, 2023

Measurement Result: This equipment was connected with indoor air quality probe and Displayed (SR) on display. Model: HM94G, Serial number: V1902214. Calibration was performed in the range of 20%RH to 80%RH.

Determined (RH%)	Standard (RH%)	UUC Reading (RH%)	Error (RH%)	Uncertainty (RH%)
20	20.04	19.3	-0.7	0.52
40	40.25	40.4	0.2	0.62
60	60.33	60.5	0.2	0.52

Performed by:  
☒ Mr. Surawit Thachai  
☒ Miss Jiraporn Lertsoonthorn  
☐ Miss Pongnaporn Phonsri



Approved Signature: Mr. Pinyas Booncharoen  
Calibration Department Manager

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ISO/IEC 17025:2017  
MCS-TSI-17025  
CALIBRATION 0367



## CERTIFICATE OF CALIBRATION

Certificate No.: CJ-025-86  
Page 2 of 2 Pages

MEASUREMENT RESULTS: ☒ Without adjustment ☐ With adjustment  
CALIBRATION IN THE RANGE OF: 1950 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)
1950.13	950.8	0.6	0.84
1976.04	976.4	0.4	0.60
1996.10	996.3	0.2	0.46
1010.08	1010.1	0.0	0.37
1030.10	1029.8	-0.3	0.50
1050.08	1049.5	-0.6	0.73

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

\* End of certificate



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ISO/IEC 17025:2017  
MCS-TSI-17025  
CALIBRATION 0367

AS special measurement laboratory  
Calibration services department

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Cup anemometer  
Manufacturer: Novapine  
Model/Type: Sensor WS-02F  
Data logger: 100-W1-250L  
Serial Number: 5890  
ID Number: 5890  
CONDITION AS RECEIVED: Customer: A.S. Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE: 13 Feb 2023  
MEASUREMENT DATE: 12 Feb 2023  
ISSUE DATE: 13 Feb 2023

ENVIRONMENTAL CONDITIONS: Ambient condition in the laboratory are as follows:  
Temperature: (25.0 ± 0.5) °C  
Relative Humidity: 50%  
Atmospheric Pressure: (1010 ± 10) mPa

PLACE OF CALIBRATION: 3000 rpm wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS: Wind tunnel cross section area: 900 cm²  
Wind direction: Upward (90°)  
Diameter of measuring pipe: 100 mm  
Reynolds Number of test object: 5.111 x 10<sup>5</sup>

Preconditioning: 24 hours at ambient conditions.  
Measurement Condition: The average value during measurement was (23.7) °C, (64.8) %RH and (1013.2) mPa.

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

Calibrated by:  
☒ Mr. Surawit Thachai  
☐ Miss Jiraporn Lertsoonthorn



Approved Signature: Mr. Pinyas Booncharoen  
Calibration Department Manager

Remarks:  
\* Quality independent area of the wind tunnel.  
\* Provided error values area of the tested object include mounting pipe.  
\* Accuracy of mounting pipe.  
\* Refer to "A"

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MCS-TSI-17025  
CALIBRATION 0367

AS special measurement laboratory  
Calibration services department

## CERTIFICATE OF CALIBRATION

Certificate No.: CJ-025-86

Page 1 of 2 Pages

MEASUREMENT ITEM: Digital barometer  
Manufacturer: Novapine  
Model/Type: Sensor: 110 WS 250L  
Data logger: 100-W1-250L-E  
Serial Number: 5890  
ID Number: 5890  
CONDITION AS RECEIVED: Customer: A.S. Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE: 14 Jun 2023  
MEASUREMENT DATE: 20 Jun 2023  
ISSUE DATE: 20 Jun 2023

CONDITION OF THIS RESULT OF CALIBRATION:

- Reference Standard Instrument: Instrument: Model: CP12500 Serial No.: 410021202 Certificate No.: MP-0205-22 Due Date: 02 Dec 2023
- Calibration effort for calibration sequence C: The UUC was calibrated in vertical orientation above reference liquid instrument and center of UUC\* was used as the reference level.
- Calibration conditions: 1. Condition: ☒ Normal ☐ Special  
Pressure transmitting medium: Air  
Pressure (kPa): 1.19 kPa  
Relative Humidity: (50 ± 10) %  
Temperature: (23.7 ± 0.5) °C  
Atmospheric Pressure: (1013.2 ± 10) mPa
- The certificate is valid only to the item, location, date and place of calibration.

Calibrated by:  
☒ Mr. Surawit Thachai  
☐ Miss Jiraporn Lertsoonthorn



Approved Signature: Mr. Pinyas Booncharoen  
Calibration Department Manager

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Page 2 of 2 Pages

## MEASUREMENT RESULTS

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 1 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 10 m/s was obtained by a standard air velocity transducer and down 5 m/s to 10 m/s was calculated by a pitot tube with precision differential pressure meter which was installed at 10 m/s and 500 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 10 m/s at collection interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

Std (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	UUC (m/s)	Error (m/s)	UUC (m/s)	UUC (m/s)
0.584	23.80	23.45	0.8	-0.2	0.5	0.5
1.051	23.80	23.45	1.0	-0.2	0.5	0.5
1.504	23.80	23.45	1.0	-0.2	0.5	0.5
4.128	23.80	23.45	5.0	-0.2	0.5	0.5
4.97	23.80	23.45	4.8	-0.1	0.18	0.18
5.96	23.84	23.45	5.9	0.0	0.18	0.18
7.04	23.58	23.45	6.9	-0.2	0.18	0.18
8.16	23.76	23.45	7.9	-0.3	0.71	0.71
9.49	23.44	23.45	9.0	-0.3	0.20	0.20
10.07	23.50	23.45	9.9	-0.2	0.28	0.28
11.14	23.24	23.45	10.8	-0.2	0.21	0.21
12.11	23.42	23.45	11.8	-0.2	0.21	0.21
13.10	23.30	23.45	12.9	-0.3	0.21	0.21
14.10	23.34	23.45	13.9	-0.3	0.21	0.21
15.17	23.30	23.45	14.9	-0.2	0.24	0.24
16.20	23.20	23.45	16.0	-0.3	0.26	0.26

Remarks:  
\* Calibration results only report for the listed environmental and operational conditions during the calibration test phase.  
\* Results of expanded.  
\* Results of Unit Under Calibration.

PHOTO OF CALIBRATION SET UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shows may differ from the calibration set-up. The proportion of the set-up is not true to scale due to image geometry.

\* End of Certificate of Calibration











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Watthana, Bangkok, 10600 Thailand.  
Tel: (66) 02-660812#13 Fax: (66) 02-6608060 www.jiranatee.com

Certificate No.: CP-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 HM90 S/N: V1902214.  
Dimension : Diameter 12 mm, Length 90 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 Petchkasem 7/71, Petchkasem Rd.,  
Watthana, Bangkok, 10600 Thailand.  
Tel: (66) 02-660812#13 Fax: (66) 02-6608060 www.jiranatee.com

Certificate No.: 194-0303/2023 Page 1 of 1 Page

**CERTIFICATE OF CALIBRATION**

Measurement Item : Relative Humidity with data logger  
Manufacturer : Nivopline  
Model/Type : I 10 WS-250L-E  
Serial Number : A5990  
ID No. : PMS-700049  
Customer : ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:  
The measurement was carried out in an ambient temperature of (25±0.5)°C, and relative humidity of (50±10)%.

Measurement Method:  
Unit Under Calibration (UUC) was calibrated by comparison method with standard utilized master hygrometer model: 1860-2 in the humidity generator chamber to determine the error.

Traceability:  
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20020-001. Due date: Sep 26, 2024.

Measurement Date : Jun 20, 2023  
Issued Date : Jun 22, 2023

Measurement Result:  
This equipment was connected with indoor air quality probe and Displayed (dR) on display. Model: HM94G, Serial number: V1902214.  
Calibration was performed in the range of 20%RH to 80%RH.  
The results of calibration are reported in table below.

Determined (RH%)	Standard (RH%)	UUC Reading (RH%)	Error (RH%)	Uncertainty (RH%)
20	20.04	19.3	-0.7	0.52
40	40.25	40.6	0.4	0.62
80	80.33	80.5	0.2	0.52

Performed by:  
☒ Mr. Soravit Thachalad  
☒ Ms. Jiraporn Lertsongthong  
☐ Ms. Pongnaporn Phonsan

Approved Signature:   
Mr. Pinyas 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.

63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.,  
Watthana, Bangkok, 10600 Thailand.  
Tel: (66) 02-660812#13 Fax: (66) 02-6608060 www.jiranatee.com

Certificate No.: CP-025-66 Page 1 of 2 Pages

**CERTIFICATE OF CALIBRATION**

MEASUREMENT ITEM : Digital thermometer  
MANUFACTURER : Nivopline  
MODEL/TYPER : Sensor: I10 WS-250P  
Data logger: I10 WS-250L-E  
SERIAL NUMBER : Sensor: SP-43380  
Data logger: A5980  
ID NUMBER : PMS-700049  
CONDITION AS-RECEIVED : New item  
CUSTOMER : ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Calibration procedure:  
The pressure calibration was done by using house calibration method as per ISO 9001 according to comparison method with digital pressure calibrator using an ODEB 6.2

Traceability:  
The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) by 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%.

RECEIVED DATE : 14 Jun 2023  
MEASUREMENT DATE : 20 Jun 2023  
ISSUE DATE : 20 Jun 2023

CONDITION OF THIS RESULT OF CALIBRATION:  
1. Reference Standard Instrument:  
Instrument : Model : Serial No. : Expiry Date :  
Absolute Pressure Transducer : CP12500 : 41001202 : MP-0205-22 : 02 Dec 2023  
2. The UUC was installed in vertical orientation above reference standard instrument and center of UUC\* was used as the reference level.  
3. Calibration conditions:  
4. Condition : ☒ Normal ☐ Abnormal  
Pressure transmitting medium : Air  
Pressure (kPa) : 1.19 kPa  
Relative Humidity : (50±10)%  
Temperature : (25±0.5)°C  
5. The certificate is valid only to the item calibrated on date and place of calibration.

Calibrated by:   
☒ Mr. Soravit Thachalad  
☐ Ms. Jiraporn Lertsongthong

Approved signature:   
Mr. Pinyas Booncharoen  
Calibration Department Manager

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

63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.,  
Watthana, Bangkok, 10600 Thailand.  
Tel: (66) 02-660812#13 Fax: (66) 02-6608060 www.jiranatee.com

Certificate No.: CP-025-66 Page 2 of 2 Pages

**CERTIFICATE OF CALIBRATION**

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

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.13	950.8	0.6	0.84
976.04	976.4	0.4	0.60
996.10	996.3	0.2	0.46
1010.08	1010.1	0.0	0.37
1020.10	1020.8	0.7	0.50
1050.08	1049.5	-0.6	0.73

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

★ End of certificate ★



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No.: 21-670292 MTC No. EEL- BP. 83/0267

**CALIBRATION CERTIFICATE**

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

Instrument Calibrated : Ambient Environment  
Description : Sound Calibrator : Temperature : (23 ± 3) °C  
Manufacturer : Eikon : 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 DE-193A S/N 122037.  
2. Measuring Amplifier Broek&Kjaer 2636 S/N 1537484.  
3. Programmable Attenuator Tansgawa TPA-303A S/N OF 2214.  
4. Digital Multimeter Agilent 34401A S/N MY4005560.  
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.  
6. Audio Analyzer Keithley 2015-P S/N4106495.  
7. Condenser Microphone B&K 4190 S/N 2889871.

Calibration Procedure: CP-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 RELATE ONLY TO THE ITEMS TESTED/DESCRIBED IN VALUE EXPRESSED.  
Submitting the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office : 51 Mo 3 Tandon Witong Rd, Amphur Witong (Liang),  
Changwat Pathumthani 12120, Thailand  
Tel: 0462 0277 9000  
Fax: 0462 0277 9009  
E-mail: aungphong@tistr.go.th

Office Laboratory : 408 Mo 3 Tandon Bangpoo, Amphur Bangpoo, Samutprakan,  
Changwat Samutprakan 10280, Thailand  
Tel: 0462 0292 1402-4040 ext. 115, 116  
Fax: 0462 0292 1400  
E-mail: tistr@tistr.go.th

Office : 104 Phatthanasak Road, Lardburi, Chitachul,  
Bangkok 10250, Thailand  
Tel: 0462 0279 1220-40 ext. 315, 316  
Fax: 0462 0279 1220  
E-mail: tistr@tistr.go.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No.: 21-670292 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 Brüel&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 Brüel&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 Brüel&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 nominal.

Calibrated by:   
Mr. Weerachai Dechathayee

Approved by:   
Mr. Pinyas Booncharoen  
Director  
Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre  
Ref: 2011267021900719001

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

End of Certificate 2/2

THE RESULTS RELATE ONLY TO THE ITEMS TESTED/DESCRIBED IN VALUE EXPRESSED.  
Submitting the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office : 51 Mo 3 Tandon Witong Rd, Amphur Witong (Liang),  
Changwat Pathumthani 12120, Thailand  
Tel: 0462 0277 9000  
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E-mail: aungphong@tistr.go.th

Office Laboratory : 408 Mo 3 Tandon Bangpoo, Amphur Bangpoo, Samutprakan,  
Changwat Samutprakan 10280, Thailand  
Tel: 0462 0292 1402-4040 ext. 115, 116  
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E-mail: tistr@tistr.go.th

Office : 104 Phatthanasak Road, Lardburi, Chitachul,  
Bangkok 10250, Thailand  
Tel: 0462 0279 1220-40 ext. 315, 316  
Fax: 0462 0279 1220  
E-mail: tistr@tistr.go.th

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-52A / Microphone UC-59 / Pre-amplifier NH-25  
Serial No.: 01120938 / 21888 / 22327  
ID No.: KYQ\_J50629

Condition As Found : GOOD

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

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

Received Date : 11 JANUARY 2024  
Calibration Date : 22-24 JANUARY 2024  
Date of Issue : 24 JANUARY 2024

Calibrated by : Natchanon Pitsupaijan

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

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

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

## Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	IF-0099-23	07-FEB-24
Waveform Generator	33511B	MY52302742	IF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 340266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 290266	13-FEB-24
Digital Multimeter	34461A	MY60034273	EEL_BP 314266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchu*

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.98)	94.0	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.4

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

Frequency Weighting	Measured value ( dB )
A-weight	9.9
C-weight	14.5
Flat	20.2

## 3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 94 dB

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	±1.0
1000	0.2	0.2	0.2	±0.7
8000	0.7	0.8	0.8	+1.5, -2.5

*T. Petchu*

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	-0.1	±1.0
500	0.0	0.0	-0.1	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+1.5, -2.5
16000	0.0	-1.2	-1.3	+2.5, -16.0

## 5. Frequency and time weighting at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A-weight	94.0	94.0	0.0	±0.1

*T. Petchu*

## Summary of Measurement Result :

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

*T. Petchu*



**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

459-4617 Srinthorn Road, Banglumru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
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**8. Level linearity including the level range control**

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±0.8

**9. Tone burst response**

Time Weighting	Tone burst duration, T <sub>b</sub> (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.0 / -3.0
	2	8	117.0	117.0	0.0	1.0 / -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 / -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0 / -3.0
	2	8	108.0	108.0	0.0	1.0 / -1.5
	200	800	128.0	128.0	0.0	±0.5

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±2.0
One	136.4	136.3	-0.1	±2.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	132.9	-0.1	±1.0
Positive half cycle	135.4	135.1	-0.3	±1.0
Negative half cycle	135.4	135.1	-0.3	±1.0

*T. Petchur*

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**CALIBRATION LABORATORY**

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**11. Overload indication**

Measured value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	89.7	0.1
Negative one-half cycle	89.7	±1.5

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petchur*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NR-42 / Microphone UC-52 / Preamplifier NII-24  
Serial No. : 0112378 / 143842 / 22771  
ID No. : RVQ\_F50017

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
194 PHATTHANAKAN 46, PHATTHANAKAN ROAD,  
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

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

Received Date : 11 JANUARY 2024  
Calibration Date : 22-24 JANUARY 2024  
Date of Issue : 24 JANUARY 2024



Calibrated by : Natsakorn Prapaisan

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

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

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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Cert. No. : ACL24072  
Job No. : VC67AC0854  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY23202742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 3010266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 3010266	14-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 3110266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42CAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchur*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
Job No. : VC67AC0854  
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**Summary of Measurement Result :**

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

*T. Petchur*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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Cert. No. : ACL24072  
Job No. : VC67AC0854  
Pages : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
16.7

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

Frequency Weighting	Measured value (dB)
A-weight	11.6
C-weight	17.7
Flat	23.4

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

Measure free-field acoustic response at a level of 94 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.5	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	±5.0

*T. Petchur*



**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

451-453/1 Srinthom Road, Banglumru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
83	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.1	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long-term stability**

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

*T. Petch.*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

451-453/1 Srinthom Road, Banglumru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 6 of 8

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
128.0	128.0	0.0	±1.1
119.0	119.1	0.1	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.1	0.1	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
29.0	29.0	0.0	±1.1
24.0	24.0	0.0	±1.1
19.0	19.0	0.0	±1.1
14.0	14.0	0.0	±1.1
9.0	9.0	0.0	±1.1
4.0	4.0	0.0	±1.1

*T. Petch.*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

451-453/1 Srinthom Road, Banglumru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
Job No. : VC67AC0054  
Pages : 7 of 8

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

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.3	-1.1	±3.0

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

*T. Petch.*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

451-453/1 Srinthom Road, Banglumru, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24072  
Job No. : VC67AC0054  
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**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

*T. Petch.*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

451-453/1 Srinthom Road, Banglumru, Bangkok, 10700 THAILAND  
Tel: +66 2433 8331 Fax: +66 2433 1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23263  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42\* Microphone UC-52 / Preamp/Filter NH-24  
Serial No. : 01122567 / 143473 / 22605  
ID No. : RYU J580016

Condition As Found : GOOD

Customer : ALE S LABORATORY GROUP (THAILAND) CO., LTD  
104 PHATTANAKAN 40, PHATTANAKAN ROAD,  
KHWAENG PHATTANAKAN, KHUET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

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

Received Date : 23 AUGUST 2023  
Calibration Date : 01 SEPTEMBER 2023  
Date of Issue : 04 SEPTEMBER 2023

Calibrated by : Natchanon Pitsupatam

Approved by : *T. Petch.*  
( Thanukul Petchun )

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

QP-TS12-04-04-020664

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

**Continuation of Calibration Certificate**

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

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

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	34461A	MY53220104	EEL-BP 3010266	13-FEB-24
Digital Multimeter	34461A	MY53220076	EEL-BP 2910266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 3110266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	06-FEB-24
Conductor Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

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

*T. Petch.*

QP-TS12-04-04-020664

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 5 of 8

## Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QP-TS12-04-04-020664

P. B. B.

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.3
Flat	24.2

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.4	±1.5
1000	-0.1	-0.1	-0.1	±1.0
8000	-2.0	-1.9	-1.9	±5.0

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Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

QP-TS12-04-04-020664

P. B. B.

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QP-TS12-04-04-020664

P. B. B.

Cert. No. : ACL23263  
Job No. : VC66AC0094  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

Time Weighting	Tone burst duration, Th (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
Once	136.4	136.1	-0.3	±3.0

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

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P. B. B.

Cert. No. : ACL23263  
Job No. : VC66AC0094  
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## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

P. B. B.

## Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-75  
Serial No.: J5002736  
ID No.: RYG\_J50496

Condition As Found : GOOD

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

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

Received Date : 19 JANUARY 2024  
Calibration Date : 26 JANUARY 2024  
Date of Issue : 29 JANUARY 2024

Calibrated by : Nithakorn Pitsupisan

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

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

Calibration Procedure : CP-AC-03

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 300266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 300267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL_BP 310266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977600	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34569405	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V74460609	EF-0012-23	10-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchur*

Result of calibration :

## 1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	93.98	-0.02	0.14	0.40

## 2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1000.0	0.0	0.1	1.0

## 3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
0.83	0.10	3.0

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

End of Calibration Certificate

*T. Petchur*

Request No. 21-670232

MTC No. EEL. BP. 172/0167

## CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Address : 104 Phattanakarn 40, Phattanakarn Rd., Khwaeng Phattanakarn, Khet Suan Luang, Bangkok 10250.  
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,  
Sri IEC, Bangpoo Industrial Estate, Sukhumvit Rd., A-Muang, Samutprakan 10280.

Instrument Calibrated :  
Description : Sound Level Meter  
Manufacturer : Rion  
Model : NL-42  
Serial No.: 00290515 (ID: RYG\_J50432)  
Microphone : Type UC-52 No.179119  
Pre-amplifier : Type NH-24 No.87526

REVIEWED BY *Nithakorn P*  
APPROVED BY *T. Petchur*  
CALIBRATION UNIT

- Standards used :
- Band Pass Filter Wavetek 752A S/N 90010494.
  - Condenser Microphone Brüel&Kjær 4180 S/N 289871.
  - Decade Attenuator Ando AI-205 S/N 00464602.
  - Function/Arbitrary Waveform Generator Agilent 33220A S/N MY4402668.
  - Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
  - Digital Multimeter Fluke 8520A S/N 4995007.
  - Power Amplifier Rion NC-72 S/N 00402446.
  - Measuring Amplifier Brüel&Kjær 2036 S/N 1337484.

Date of Receipt : 24 Jan. 2024  
Date of Calibration : 22-28 Feb. 2024

The results relate only to the items described/checked or value assigned.  
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Request No. 21-670232

MTC No. EEL. BP. 172/0167

- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tannoy Limited, Great Britain British Patent No. 175300.
- Digital Multimeter Agilent 34401A S/N MY4400560.
- Programmable Attenuator Tannogoo TPA-303A S/N 2212.

Calibration Procedure :

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

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

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

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

Date of Calibration : 22-28 Feb. 2024

The results relate only to the items described/checked or value assigned.  
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Request No. 21-670232

MTC No. EEL. BP. 172/0167

## 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 7 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.96	114.1	113.9	-0.1	1.0	0.30	N/A

Note: The external calibration adjustment was finely performed. The internal calibration adjustment was then completed at the display of 123.6 dB.

## 2. Self-generated noise

## 2.1 Normal test

Measured value (dB)	Uncertainty (dB)	Maximum permitted uncertainty of measurement (dB)
19.1	0.10	N/A

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

Frequency (Hz)	Measured value (dB)	Uncertainty (dB)	Maximum permitted uncertainty of measurement (dB)
Weighting			
A-Weight	11.9	0.10	N/A
C-Weight	17.4	0.10	N/A
Flat	21.2	0.10	N/A

Date of Calibration : 22-28 Feb. 2024

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.2	0.2	1.5	0.45	0.6
1 000	-0.1	-0.1	-0.1	1.0	0.45	0.6
8 000	0.0	0.0	-0.1	5.0	0.45	0.7

### 4. Electrical signal test of frequency weightings

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

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
54	54.0	0.0	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	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	28.0	0.0	1.1	0.30	0.3
27	27.0	0.0	1.1	0.30	0.3
26	26.0	0.0	1.1	0.30	0.3
25	25.0	0.0	1.1	0.30	0.3

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

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

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### 5. Long-term stability

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

### 6. Frequency and time weightings at 1 kHz

#### 6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

#### 6.2 Time weightings at 1 kHz

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

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### 7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.1	0.1	1.1	0.30	0.3
130	130.1	0.1	1.1	0.30	0.3
129	129.1	0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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### 10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	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	135.4	0.0	1.5	0.55
Negative one-half cycle	135.4	0.0	1.5	0.55

### 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 :   
(Mr. Pannat Phungern)

Approved by :   
(Mr. Pannat Phungern)

Electrical and Metrology Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

End of Certificate

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# CALIBRATION CERTIFICATE

**Submitted by** : ALS Laboratory Group (Thailand) Co., Ltd.  
**Address** : 104 Phantanasarak 40, Phantanasarak Rd., Klongkum, Khet Suan Luang, Bangkok 10250.  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,  
 Site 1C, Bangso Industrial Estate, Subhomet Rd., A.Muang, Samprakan 10280.

**Instrument Calibrated** :  
**Description** : Sound Level Meter  
**Manufacturer** : Rion  
**Model** : NL-42  
**Serial No.** : 00296516 (ID: RYG\_P50433)  
**Microphone** : Type UC-52 No.180412  
**Preamplifier** : Type NH-24 No.88182

**Standards used** :  
 1. Hand Pans Filter Wavelet 752A S/N 90010494.  
 2. Condenser Microphone Briel&Kjaer 4130 S/N 2809871.  
 3. Decade Attenuator Ando AL-205 S/N 09484002.  
 4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY4404268.  
 5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.  
 6. Digital Multimeter Fluke 8520A S/N 4955007.  
 7. Pinphone Rion NC-72 S/N 00403446.  
 8. Measuring Amplifier Briel&Kjaer 2636 S/N 1537484.

**Date of Receipt** : 24 Jan. 2024  
**Date of Calibration** : 22-28 Feb. 2024

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- Power Amplifier Briel&Kjaer 2706 S/N 1517600.
- Speaker Tannoy Limited, Great Britain British Patent No. 215300.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tannagawa TPA-303A S/N 2212.

## Calibration Procedure :

This instrument was calibrated by using calibration procedures in 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** : 22-28 Feb. 2024

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## 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
113.96	114.1	113.9	-0.1	1.0	0.30

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.1 dB.

## 2. Self-generated noise

### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
18.9	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	12.3	0.10	N/A
C-Weight	17.7	0.10	N/A
Flat	23.1	0.10	N/A

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## 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
125	0.0	0.2	0.1	0.45
1 000	0.0	0.0	0.0	0.45
8 000	-0.3	-0.3	-0.3	0.45

## 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
63	-0.1	0.0	0.0	0.20
125	-0.1	0.0	0.0	0.20
250	0.0	0.0	0.0	0.20
500	0.0	0.0	0.0	0.20
1 000	0.0	0.0	0.0	0.20
2 000	0.0	0.0	0.0	0.20
4 000	0.0	0.0	0.0	0.20
8 000	0.0	0.0	0.0	0.20

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## 5. Long-term stability

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

## 6. Frequency and time weightings at 1 kHz

### 6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

### 6.2 Time weightings at 1 kHz

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

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## 7. Level linearity on the reference level range

Assigned value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

**Date of Calibration** : 22-28 Feb. 2024

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 Tel. 0462 2577 9000  
 Fax. 0462 2577 9009  
 E-mail : mtc@tistr.or.th

**Office** : 104 Phantanasarak Rd., Chantabok, Bangkok 10260, Thailand  
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 E-mail : mtc@tistr.or.th

PAB.MTC.002 Rev.4



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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
54	54.0	0.0	1.1	0.30	0.3
49	48.9	-0.1	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	28.8	-0.2	1.1	0.30	0.3
24	23.8	-0.2	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.8	-0.2	1.1	0.30	0.3

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

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

Date of Calibration : 22-28 Feb. 2024

The results relate only to the items tested/calibrated or value assigned.  
Adhering the Report/Certificate and validity of the results except in full are prohibited unless written permission is obtained from the generator of TISTR.

Head Office  
25 Suk 3, Tambon Wangmo, Amphoe Wangmo, Changwat Pathumthani 12120, Thailand  
Tel. 060 0 2577 9000  
Fax. 060 0 2577 9009  
E-mail : sarnpaphon@tistr.th

Office Laboratory  
Soi 10, Bangkang Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10180, Thailand  
Tel. 060 0 2577 9000  
Fax. 060 0 2577 9005  
E-mail : mtc@tistr.th

Office  
106 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand  
Tel. 060 0 2577 9000  
Fax. 060 0 2577 9002  
E-mail : sarnpaphon@tistr.th

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

### 9. Tone burst response

Time	Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum permitted uncertainty of measurement (±dB)
Weighting	Duration, T <sub>b</sub> (ms)					
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0, -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5, -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0, -5.0	0.20	0.3

Date of Calibration : 22-28 Feb. 2024

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Adhering the Report/Certificate and validity of the results except in full are prohibited unless written permission is obtained from the generator of TISTR.

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25 Suk 3, Tambon Wangmo, Amphoe Wangmo, Changwat Pathumthani 12120, Thailand  
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Office Laboratory  
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E-mail : mtc@tistr.th

Office  
106 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand  
Tel. 060 0 2577 9000  
Fax. 060 0 2577 9002  
E-mail : sarnpaphon@tistr.th

### 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	125.5	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	Acceptance limit	Uncertainty	Maximum permitted uncertainty
Positive one-half cycle	Negative one-half cycle	value (dB)	class 2 (±dB)	(±dB)	of measurement (±dB)
135.4	135.4	0.0	1.5	0.55	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				
End	129.0	0.0	0.3	0.10	0.1

Calibrated by :   
(Mr. Pannat Phasinger)

Approved by :   
Director  
Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre  
Ref : 201126701400347003

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

End of Certificate

9 / 9

The results relate only to the items tested/calibrated or value assigned.  
Adhering the Report/Certificate and validity of the results except in full are prohibited unless written permission is obtained from the generator of TISTR.

Head Office  
25 Suk 3, Tambon Wangmo, Amphoe Wangmo, Changwat Pathumthani 12120, Thailand  
Tel. 060 0 2577 9000  
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E-mail : sarnpaphon@tistr.th

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106 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand  
Tel. 060 0 2577 9000  
Fax. 060 0 2577 9002  
E-mail : sarnpaphon@tistr.th

## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Srinthorn Rd.,Bangbunru, Bangkok 10700 THAILAND.  
Tel.0-2433-8800 Fax.0-2433-4679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACC23029  
Pages : 1 of 3

### Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-74  
Serial No. : 34178123  
ID No. : RYG, F50215

Condition As Found : GOOD

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

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

Received Date : 07 SEPTEMBER 2023  
Calibration Date : 20 SEPTEMBER 2023  
Date of Issue : 20 SEPTEMBER 2023

Calibrated by : Nakhorn Pitsuphan

Approved by :   
( Nakhorn Pitsuphan )

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

## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

### Continuation of Calibration Certificate

Cert. No. : ACC23029  
Job No. : VC66ACB100  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

### Calibration Method :

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

### Condition of this result of calibration :

#### 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EE-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EE1-BP 3010266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EE1-BP 3010267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EE1-BP 3110266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V74480669	EF-0012-23	10-FEB-24

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

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

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

## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

### Continuation of Calibration Certificate

Cert. No. : ACC23029  
Job No. : VC66ACB100  
Pages : 3 of 3

### Result of calibration :

#### 1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	94.1	0.10	0.14	0.40

#### 2. Frequency

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

#### 3. Total distortion

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

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

End of Calibration Certificate

Cert. No.: ACL24036  
Pages: 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Pre-amplifier N01-24  
Serial No.: 0062395 / 198642 / 26423  
ID No.: RYG\_F30620

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2024  
Calibration Date : 12-15 JANUARY 2024  
Date of Issue : 16 JANUARY 2024



Calibrated by : Natchanon Petchuraisi

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

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Cert. No.: ACL24036  
Job No.: VC07AC0052  
Pages: 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017078	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52502742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 200266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 200266	13-FEB-24
Digital Multimeter	34461A	MY60034273	EEL-BP 316266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchuraisi*Cert. No.: ACL24036  
Job No.: VC07AC0052  
Pages: 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Nominal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A-weight	9.9
C-weight	16.5
Flat	22.3

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.7	0.8	0.8	±5.0

*T. Petchuraisi*Cert. No.: ACL24036  
Job No.: VC07AC0052  
Pages: 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long-term stability

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

*T. Petchuraisi*Cert. No.: ACL24036  
Job No.: VC07AC0052  
Pages: 3 of 8

## Summary of Measurement Result :

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

*T. Petchuraisi*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

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Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 7 of 8

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

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

**9. Tone burst response**

Time Weighting	Tone burst duration, T <sub>b</sub> (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5; -5.0
	2	8	117.0	117.0	0.0	1.0; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5; -5.0
	200	800	127.8	127.6	-0.2	±1.0
	0.25	1	99.0	98.9	-0.1	1.5; -5.0
SEL	2	8	108.0	108.0	0.0	1.0; -2.5
	200	800	128.0	128.0	0.0	±1.0

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.1	-0.3	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.3	-0.1	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

T. Pich.

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Cert. No. : ACL24036  
Job No. : VC67AC0052  
Pages : 8 of 8

**11. Overload indication**

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.7	0.0	±1.5

**12. High level stability**

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

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

End of Calibration Certificate

T. Pich.

**SITHIPORN ASSOCIATES CO., LTD.**  
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Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24034  
Pages : 1 of 8

**Calibration Certificate**

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preampifier N10-24  
Serial No. : 00623393 / 198640 / 26421  
ID No. : RYG\_F50618

Condition As Found : GOOD

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

Location : -  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %  
Received Date : 05 JANUARY 2024  
Calibration Date : 12-15 JANUARY 2024  
Date of Issue : 16 JANUARY 2024



Calibrated by : Nuthakorn Pitsupaisan

Approved by : T. Pich.  
( Thanakol Petchursi )

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Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 2 of 8

**Calibration Procedure : CP-AC-01**

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-3P 3010266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-3P 2902066	13-FEB-24
Digital Multimeter	34461A	MY60024773	EEL-3P 3102066	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

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

T. Pich.

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Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 3 of 8

**Summary of Measurement Result :**

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

T. Pich.

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**CALIBRATION LABORATORY**

459-453 Srinthorn Road, Bangkum, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A-weight	10.8
C-weight	17.4
Flat	23.3

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

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	±1.5
1000	0.1	0.1	0.1	±1.0
8000	-0.3	-0.2	-0.2	±0.0

T. Pich.



**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

491-493 Srinakharin Road, Bangna, Bangkok, 10700 Thailand  
Tel: +66 2433 8330 Email: calibration@sithiporn.com



Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

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

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

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long-term stability**

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

*T. Pich.*

**SITHIPORN ASSOCIATES CO., LTD.**  
**CALIBRATION LABORATORY**

491-493 Srinakharin Road, Bangna, Bangkok, 10700 Thailand  
Tel: +66 2433 8330 Email: calibration@sithiporn.com



Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 6 of 8

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
177.0	177.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
29.0	29.0	-0.1	±1.1
24.0	24.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.1	0.1	±1.1
25.0	24.9	-0.1	±1.1

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Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 7 of 8

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

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

**9. Tone burst response**

Time Weighting	Tone burst duration, T <sub>b</sub> (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	96.0	96.0	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

**10. Peak C-mux level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.5	-0.9	±3.0

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

*T. Pich.*

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Tel: +66 2433 8330 Email: calibration@sithiporn.com



Cert. No. : ACL24034  
Job No. : VC67AC0052  
Pages : 8 of 8

**11. Overload indication**

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	-0.1	±1.5
89.7	89.6		

**12. High level stability**

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

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

End of Calibration Certificate

*T. Pich.*



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
304/1 PATTANAKARN ROAD 301 BL. SIAM-LUANG, SIAM-LUANG, HANOI, HANOI  
TEL: 8-2713-3880-24 FAX: 8-2719-5484



**Certificate of Calibration**

Certificate No. : 23E3924  
Page : 1 of 2

Equipment : pH Meter  
Manufacturer : Matter Toledo  
Model : SevenExcellence  
Serial No. : 8034291445  
ID No. : RYO\_END0152  
Condition As-Received : Used Item  
Received Date : 08 December 2023  
Calibration Date : 14 December 2023  
Reference : 2312-0151/DC  
Ambient Temperature : ( 23 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Ruyong Branch  
815/10 Moo 5, T. Khammoo, A. Phakdiwang,  
Ruyong 21145, Thailand

Procedure used : Calibration was conducted using calibration procedure No. CP-E17 according to EURAMET ng-15.

**Condition of this result of calibration**

**1. Reference standards instruments :**

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	552A	2420802	EE-0041-23	28 Apr 2024

2. The result of calibration was made on request at the point specified by customer.  
3. The certificate is valid only in the item calibrated on date and place of calibration.  
4. This Certificate is traceable to the International System of Unit maintained through:-  
- National Institute of Metrology (NIMT)

REVIEW BY : N. Banwitt  
APPROVED BY : D. Banwitt  
NEXT CAL. DATE : 2024/04/28

Calibrated by : Naphachon Prasomkosit  
Issue Date : 15 December 2023  
Approved Signature :  
/ Prathana Prathapap  
/ Nattawat Khanchai  
/ Pongkajorn Boonpraporn

n 0331106



Result of calibration: (*) Without adjustment ( ) After adjustment		Range: 2000 mV	
Function: DC voltage measurement	Standard Value ( mV )	UUC <sup>1</sup> Reading ( mV )	Uncertainty ( ± μV )
	-200.0000	-199.9	0.1
	-150.0000	-150.0	0.0
	-100.0000	-100.0	0.0
	-50.0000	-50.0	0.0
	0.0000	0.0	0.0
	50.0000	50.0	0.0
	100.0000	100.0	0.0
	150.0000	150.0	0.0
	200.0000	199.9	-0.1

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<sup>1</sup>= Unit Under Calibration.

-000-

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

n 1193422





Cert.No.: 23CH1574  
Page: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenExcellence  
Serial No. : B834291445  
ID No. : RYQ\_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  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In-house method :  
- CP-CHS by direct measurement with standard  
voltage calibrator and direct measurement with  
certified reference material (CRM)  
- CP-CHS by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :  
Sathip Meangmai  
Warakorn Lemgagrakul  
Ponpan Paipim

Issue Date : 19 December 2023

The Uncertainties are for a confidence probability of approximately 95%  
This certificate may not be reproduced unless this is full, except with the prior written  
approval of the head of Corporate Services & Equipment Calibration and Testing Services.

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 23E2002 27 Aug 2024  
2) Ref. Standard Thermometer 4862054 110RC044 23G08 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. AN-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	913598	14 July 2025
pH 6.860	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
	pH	mV	mV	pH		
pH Meter S/N: B834291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

a 1193852



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	164.1	0.0045	2.00
	6.866	6.998	8.7	0.0084	2.00
	9.997	10.002	-164.7	0.0088	2.11

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLabExpert 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 %.

-00-

a 1193851



Cert.No.: 23TW168  
Page: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYQ\_EN0032  
Received Date : 21 July 2023  
Test Date : 24 July 2023  
Reference : 2307-0713DSC-1  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
Rayong Branch  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand  
Laboratory Condition : Temperature ( 25 ± 5 ) °C  
Humidity ( 50 ± 20 ) %  
Test Procedure : In-house method : CP-CH9  
by Comparison Technique with Acidic Modification Method

Tested by : Wataek Sirithan

Approved by :  
Sathip Meangmai  
Warakorn Lemgagrakul

( ) Molee Buthana  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 26 July 2023

A 0320211



Cert.No.: 23TW168  
Page: 2 of 2

### Condition of this result of calibration

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	130BU10	23CG1172	22 Mar 2025	
2) Balance	1126143764	140RC004	22 Mar 2025	

Material	Manufacturer	Lot No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763318	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Acidic Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

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

-00-

a 1172155



Cert.No.: 23LM125  
Page: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYQ\_EN0032  
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 : 25 July 2023  
Calibrated Date : 27 July 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
AC Line Voltage : ( 220 ± 22 ) V

Calibrated by : Prascha Hahab

Approved by :  
Sathip Meangmai  
Warakorn Lemgagrakul

( ) Pornthippa Tameyakhul  
( ) Molee Buthana  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced unless this is full, except with the prior written  
approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0053616

**Equipment:** DO Meter with Sensor  
**Condition As-Received:** Used Item  
**Reference:** 2307-0713DS-2  
**Procedure Used:** Calibration were conducted using in-house calibration procedure CP-Q101 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.  
**Condition of this result of calibration:** The temperature scale used was based on ITS-90.  
**1. Reference standard instrument:**  

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	221285	TPA	21 Oct 2023

  
**2. This certificate is valid only to the item calibrated on date and place of calibration.**  
**3. This certification is traceable to the International System of Unit.**  
**Remark:** TPA : Technology Promotion Association (Thailand - Japan)  
**Result of Calibration:** ( ° ) Without Adjustment  
**Function:** Temperature measurement  
**This instrument was connected with temperature sensor, S/N: 1228475387**  


Point (°C)	Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor #
20.00	100	20.011	19.91	-0.101	0.15	2.00

  
**UUC\*:** Unit Under Calibration  
**The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.**  
**-00-**

a 1159515

**TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)**  
**CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES**  
3444 PATTANAPONG ROAD 101 IL SEANGANG, SEANGANG KANOKOR 4020  
TEL. 9-2377-3880-39 FAX. 9-2378-9446

**Certificate of Calibration**

**Equipment:** Low Temp. Incubator  
**Manufacturer:** Memmert  
**Model:** IPP750  
**Serial No.:** V816.0084  
**ID No.:** RYG\_EN0154  
**Submitted by:** ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
61610 Moo 5 T. Maenam Khu,  
A. Phakdaeng, Rayong 21140 Thailand  
BOD Room  
**Location:**  
**Received Order:** 29 May 2023  
**Calibration Date:** 29 May 2023  
**Ambient Temperature:** ( 26 ± 10 ) °C  
**Relative Humidity:** ( 50 ± 30 ) %  
**Calibrated by:** Man Patanapongboon  
**Approved by:**   
( ) Pongthippa Tamsayuk  
( ) Malee Budruas  
(✓) Suwit Injai  
**Issue Date:** 7 June 2023  
**The Uncertainties are for a confidence probability of approximately 95%.**  
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A 0054967

**Equipment:** Low Temp. Incubator  
**Condition As-Received:** Used Item  
**Reference:** 2305-0688OC-2  
**Procedure Used:** Calibration were conducted using calibration procedure CP-Q102 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).  
**Condition of this result of calibration:** The temperature scale used was based on ITS-90.  
**1. Reference standard instrument:**  

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34872A	MY57013711	221M83	02 Jul 2023

  
**2. This certificate is valid only to the item calibrated on date and place of calibration.**  
**3. This certification is traceable to the International System of Unit.**  
**Result of Calibration:** ( ° ) Without Adjustment  
**Function of UUC\*:** Temperature Source  
**Fresh air setting:** Close  
**Environment during calibration**  

	Beginning	Finished
Temp. (°C)	23	23
REL Humid. (%)	54	56
AC Supply (Volt)	223	222

  
**Probe Installation Details:**  

Position	Ref. Std. ID No.
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

  
**Dimension of Chamber:**  

Dimension	Value
D	0.80 m
W	1.0 m
H	1.2 m
Capacity	0.75 m³

  
**-00-**

a 1165130

**Equipment:** Low Temp. Incubator  
**Condition As-Received:** Used Item  
**Reference:** 2305-0688OC-2  
**Result of Calibration:** ( ° ) Without Adjustment  
**Function of UUC\*:** Temperature Source  
**Fresh air setting:** Close  

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor
20.0	20.0	20.0	0.019	0.72	1.0	2

  
**Calibration Point**  


Point (°C)	1	2	3	4	5	6	7	8	9 (ref.)	Uncertainty (± °C)
20.0	19.547	19.790	19.487	19.529	19.408	20.139	20.112	20.406	20.116	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 %.**  
**-00-**

a 1165129

**TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)**  
**CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES**  
3444 PATTANAPONG ROAD 101 IL SEANGANG, SEANGANG KANOKOR 4020  
TEL. 9-2377-3880-39 FAX. 9-2378-9446

**Certificate of Calibration**

**Equipment:** Burette  
**Capacity:** 50 mL  
**Serial No.:** -  
**ID No.:** RYG\_EN0216  
**Manufacturer:** Witeg  
**Made in:** Germany  
**Submitted by:** ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
61610 Moo 5, T. Maenam Khu,  
A. Phakdaeng, Rayong 21140 Thailand  
**Ambient Temperature:** (20 ± 2.5) °C  
**Relative Humidity:** (50 ± 10) %  
**Barometric Pressure:** 756 mmHg  
**Calibration Procedure:** ASTM E 542 - 01  
**Calibrated by:** Sruada Khamtha  
**Approved by:**   
( ) Pongpan Papiin  
(✓) Sruada Khamtha  
( ) Saengsakorn Wongsa  
**Issue Date:** 20 September 2023  
**The Uncertainties are for a confidence probability of approximately 95%.**  
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A 0058881

**Equipment:** Burette  
**Received Date:** 19 September 2023  
**Condition As-Received:** Used Item  
**Calibration Date:** 25 September 2023  
**Reference:** 2309-0635DSG-31  
**Condition of this result of calibration:**  
**1. Reference Standard Instruments:**  

Instruments	Model	Serial No.	ID No.	Certificate No.	Traceability	Due date
1) Balance	MS204TS	C226358883	140RC010	TH0069-012	METTLER	29 Sep 2023
2) Thermo-Hygrometer	TH04-CE	00016540	140EC001	23H1275	TPA	09 June 2024
3) Thermometer		1594592	140EC010	23H158	TPA	12 Feb 2024

  
**2. This certificate is valid only to the item calibrated on date and place of calibration.**  
**3. True value is converted to true volume of the standard temperature of 20 °C.**  
**Calibration result:**  

Nominal capacity (mL)	Reading (mL)	Uncertainty (± mL)	k Factor
10	10.0224	0.0062	2.00
20	20.0064	0.0065	2.00
30	29.9831	0.0069	2.00
40	39.9910	0.0094	2.00
50	49.9806	0.010	2.00

  
**Remark:** mL = cm³  
**The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.**  
**-00-**

a 1182477





SARTORIUS

# Certificate of Calibration

REVIEW BY: *Thankak*  
APPROVED BY: *Dhan*  
NEXT CAL DATE: 21/03/2025

Model Number: MSE224S-100-DU  
Description: Analytical Balance  
Serial Number: 0028207038  
ID No.: RYG\_EN0002  
Manufacturer: Sartorius  
Page No.: 1 of 2

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

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

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

Metrological data:  
Capacity: 220 g Readability: 0.0001 g  
Ambient Conditions:  
Temperature: 24.2 °C ± 5.0 °C  
Humidity: 57.0 % RH ± 10.0 % RH  
Pressure:   
Equipment Condition: ☒ Best Operate ☐ Re

Reasons for calibration  
☒ New Installation ☐ Service / Repair ☒ Recalibration / 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 National Standards, which realize the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Model Number	Description	Traceability	Certificate No.	Due Date
YC6011-522-00	Sartorius weight set 1mg - 5000g 82 °C/8011-522-00	TCS	M23081875	23-Aug-2025
MHB-382SD	Humidity/Balance/Temp. Lutron MHB-382SD	DKSH	C16231845	23-Aug-2024

This certificate relates and apply this equipment only.  
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Sartorius (Thailand) Co., Ltd.

SOP FM 33 03 February 2022

*Chonchal Inthana* (Technical Manager)  
SARTORIUS  
THAILAND

SARTORIUS

# Certificate of Calibration

Model Number: MSE224S-100-DU  
Description: Analytical Balance  
Serial Number: 0028207038  
ID No.: RYG\_EN0002  
Manufacturer: Sartorius  
Page No.: 2 of 2

## Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The repeatability is the ability of a weighing instrument to display nearly identical results under constant test conditions when the same load within a measurement capacity is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to measure repeatability quantitatively.		The eccentric loading error is caused by the difference between the position of the load (e.g. 100 g or 10 g of mass) placed at the middle of the weighing pan and between each of four additional measurement points (positions defined according to DIN 109).	
Nominal Value : (Low Load)	20.0000 199.9999	Nominal value : 100 g	
20 g	20.0000 200.0000	Tolerance : 0.0004 g	
Tolerance : 0.0001 g	20.0001 200.0000		
20.0000 199.9999			
20.0001 200.0000			
Nominal Value : (High Load)	19.9999 200.0000		
200 g	20.0000 200.0000		
Tolerance : 0.0001 g	19.9999 199.9999		
19.9999 200.0000			
Standard Deviation	0.00007 0.00006		

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance : 0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
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

SOP FM 33 03 February 2022



# Certificate of Calibration

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

Equipment: Hot Air Oven  
Manufacturer: Memmert  
Model: UFE 800  
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. Phukdaeng, 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 Pattanapongpaiboon

Approved by: *Man Pattanapongpaiboon*  
Approved Signatory

( ) Ponthipha Taneyakul  
( ) Unnophot Harachai  
(x) Suwit Injai

Issue Date: 22 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment: Hot Air Oven  
Condition As-Received: Used Item  
Reference: 2403-0563OC-1  
Page: 2 of 3

Procedure Used : Calibration was conducted using calibration procedure CP-0702 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

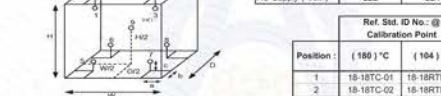
- Reference standard instrument.
- Data Acquisition
- This certificate is valid only to the item calibrated on date and place of calibration.
- This certification is traceable to the International System of Unit.

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

Result of Calibration : ( ) Without Adjustment

Function of UUC : Temperature Source

Fresh air setting : Close



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

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

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



Equipment: Hot Air Oven  
Condition As-Received: Used Item  
Reference: 2403-0563OC-1  
Page: 3 of 3

Result of Calibration : ( ) Without Adjustment

Function of UUC : Temperature Source

Fresh air setting : Close

Calibration Point	UUC Setting	UUC Reading	Temperature stability	Temperature uniformity	Overall Variation	Coverage Factor
(°C)	(°C)	(°C)	(± °C)	(°C)	(°C)	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	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.: 24TM634  
Page: 1 of 3

Equipment: Hot Air Oven  
Manufacturer: Memmert  
Model: UF 110  
Serial No.: B423.0653  
ID No.: RYG\_EN0213

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

Location: Oven Room

Received Order: 21 March 2024  
Calibration Date: 21 - 22 March 2024  
Ambient Temperature: (26 ± 10) °C  
Relative Humidity: (50 ± 30) %

Calibrated by: Man Pattanapongpaiboon

Approved by: *Man Pattanapongpaiboon*  
Approved Signatory

( ) Ponthipha Taneyakul  
( ) Unnophot Harachai  
(x) Suwit Injai

Issue Date: 23 March 2024

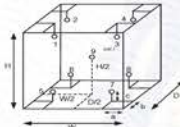
The Uncertainties are for a confidence probability of approximately 95%

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**Equipment:** Not Air Oven  
**Condition As-Received:** Used Item  
**Reference:** 2403-0563OC-3  
**Procedure Used:** Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.  
The temperature scale used was based on ITS-90.

**Condition of this result of calibration**  
1. Reference standard instrument:  
Instrument Serial No. Cert. No. Traceable Due Date  
1) Data Acquisition MYS7013711 23.M115 TPA 11 Jul 2024  
2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This certification is traceable to the International System of Unit.

**Remark:** TPA : Technology Promotion Association (Thailand - Japan)  
**Result of Calibration:** ( ° ) Without Adjustment  
**Function of UUC:** Temperature Source  
**Fresh air setting:** Close



**Environment during calibration**

	Beginning	Finished
Temp. ( °C )	27	27
REL.Humd. ( % )	59	59
AC Supply ( Vol )	224	223

**Ref. Std. ID No. : @ Calibration Point**

Position :	( 180 ) °C	( 104 ) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	23-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09

**Probe Installation Details :** Dimension of Chamber :  
a = 5.0 cm D = 0.40 m  
b = 5.0 cm W = 0.56 m  
c = 5.0 cm H = 0.48 m  
Capacity = 0.11 m<sup>3</sup>

**Equipment:** Not Air Oven  
**Condition As-Received:** Used Item  
**Reference:** 2403-0563OC-3  
**Result of Calibration:** ( ° ) Without Adjustment  
**Function of UUC:** Temperature Source  
**Fresh air setting:** Close

Calibration Point ( °C )	UUC Setting ( °C )	UUC Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor
104.0	104.0	104.0	0.005	0.52	0.90	2
180.0	180.0	180.0	0.20	1.2	2.0	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty ( ± °C )
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.508	103.898	103.712	103.772	103.730	104.289	103.805	103.798	0.42
180.0	180.701	179.239	179.935	179.999	180.127	180.138	180.895	179.313	180.211	1.1

**Average:** The average of 30 values in each position.  
**Temperature stability:** One-half of the greatest maximum difference of measured temperature at any one sensor.  
**Temperature uniformity:** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.  
**Overall Variation:** The Difference of the maximum and minimum measured temperatures throughout observation.  
**UUC:** Unit Under Calibration  
**Note:** The reported uncertainty of measurement was included stability and excluded uniformity.  
The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.

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**Equipment:** Water Bath  
**Manufacturer:** Memmert  
**Model:** WB622  
**Serial No.:** L513.0648  
**ID No.:** RYQ\_EN0061  
**Submitted by:** ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5, T. Maenam Khu, A. Phukdaeng, Rayong 21140, Thailand  
Wet Chemistry Lab  
**Location:**  
**Received Order:** 21 March 2024  
**Calibration Date:** 21 March 2024  
**Ambient Temperature:** ( 26 ± 10 ) °C  
**Relative Humidity:** ( 50 ± 30 ) %  
**Calibrated by:** Man Pattanapongpaboon  
**Approved by:**   
( ) Pomtipote Tamayakul  
( ) Unnopphol Hanachai  
(x) Suwit Injai  
**Issue Date:** 23 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:** 2403-0563OC-4  
**Procedure Used:** 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.

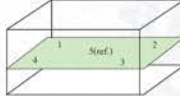
**Condition of this result of calibration**  
1. Reference standard instrument:  
Instrument Serial No. Cert. No. Traceable Due Date  
1) Data Acquisition MYS7013711 23.M115 TPA 11 Jul 2024  
2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This certification 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 ( °C )		AC Voltage Supply ( Volt )
Beginning of Calibration	25	55	222
Finished of Calibration	25	57	223

**Ref. Std. ID No.:**

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



From

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

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
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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**Equipment:** pH Meter  
**Manufacturer:** Mettler Toledo  
**Model:** SevenGo S2  
**Serial No.:** C221115514  
**ID No.:** RYQ\_F80596  
**Condition As-Received:** Used Item  
**Received Date:** 30 June 2023  
**Calibration Date:** 03 July 2023  
**Reference:** 2306-0884DSC-6  
**Submitted by:** ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch  
616/10 Moo 5, T. Maenam Khu, A. Phukdaeng, Rayong 21140, Thailand  
**Ambient Temperature:** ( 26 ± 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:** Wansorn Lemgagrakul  
**Approved by:**   
(x) Malee Subvutse  
( ) Sathit Mueangrai  
( ) Wansorn Lemgagrakul  
**Issue Date:** 6 July 2023

**The Uncertainties are for a confidence probability of approximately 95%**  
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A 0055863







ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

ชนิดเครื่อง: Block Digestion Unit      รุ่น: KT-20s      เลขที่ใบงาน: WO-00020429  
หมายเลขเครื่อง: 5720210008/577000073

ตรวจสอบ (By)		รายการตรวจสอบ	ตรวจสอบ (At)		พบข้อบกพร่อง
11 Mar 2024			11 Mar 2024		
ผ่าน	ไม่ผ่าน		ผ่าน	ไม่ผ่าน	
General					
<input type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	5. สลัก Hold	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สลักเข้าป้อน	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input type="checkbox"/>	<input type="checkbox"/>	7. สลักดึงลิ้น	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. สลักแรงดัน ทุ. สลักถังเก็บน้ำ	<input type="checkbox"/>	<input type="checkbox"/>	

ชื่อลูกค้า: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Mr. Thanathorn Phunook  
Service Engineer

DKSH Business Services (Thailand) Co., Ltd.  
250/1 Sukhumvit Road, 25th Floor, Sukhumvit 22, Bangkok 10110  
Phone: 02-2626 1100 | Email: dksh-bizserv@dksh.com | Website: www.dksh-bizserv.com