

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
1. คุณภาพอากาศในบรรยากาศ		
TSP	High Volume Air Sampler Rec No. Blower No. R06, R07, R16	Digital Balance
PM ₁₀	High Volume Air Sampler Rec No. Blower No. R17	Digital Balance
SO ₂	SO ₂ Analyzer No. R03	SO2 Analyzer No. R03
NO _x	NO/NOx/NO2 Analyzer No. R06	NO/NOx/NO2 Analyzer No. R06
2. คุณภาพอากาศจากปล่องระบาย		
Total Suspended Particulate	Console No. B03, B04 Pitot Tube No. B41	Digital Balance
Oxides of Nitrogen	Vacuum Gauge	Spectrophotometer
Sulfur Dioxide	Personal Pump SKC No. B52, B72 Rotameter No. H-R04, H-R05	-
Carbon Monoxide	Personal Pump SKC No. B48, B71 Rotameter No. H-R04, H-R05	CO Analyzer No. R02
Lead	Console No. B03, B04 Pitot Tube No. B41	ICP
Mercury	Console No. B03, B04 Pitot Tube No. B41	AAS
Hydrogen Sulfide	Personal Pump SKC No. B71 Rotameter No. H-R05	-
3. คุณภาพน้ำ		
pH	-	pH Meter
4. ระดับเสียงทั่วไป		
L _{eq} 24 hr	Acoustic Calibrator	-
5. ระดับเสียงในสถานประกอบการ		
L _{eq} 8 hr และ Octave Band	Acoustic Calibrator	-
6. ระดับเสียงติดตามตัวบุคคล		
TWA	Acoustic Calibrator	-
7. คุณภาพอากาศในสถานประกอบการ		
Hydrogen Sulfide	Personal Pump SKC No. R01, R13, R14, R15, R17, R21, R24, R38 Rotameter No. L-R01, L-R05	GC/FID

คุณภาพอากาศในบรรยากาศ



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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
B35	B35	03/11/2022	$y = 1.306x - 9.466$	0.997
B36	B36	02/11/2022	$y = 1.213x - 5.932$	0.996
B37	B37	01/11/2022	$y = 1.253x - 5.209$	0.999
B38	B38	01/11/2022	$y = 1.228x - 5.530$	0.995
B39	B39	01/11/2022	$y = 1.319x - 9.149$	0.998
B40	B40	01/11/2022	$y = 1.196x - 4.045$	0.999
B41	B41	07/11/2022	$y = 1.179x - 2.611$	0.999
B42	B42	01/11/2022	$y = 1.209x - 3.713$	0.995
B43	B43	02/11/2022	$y = 1.187x - 3.331$	0.998
B44	B44	07/11/2022	$y = 1.298x - 8.171$	0.996
R01	R01	02/11/2022	$y = 1.289x - 8.287$	0.998
R02	R02	07/11/2022	$y = 1.307x - 10.165$	0.999
R03	R03	03/11/2022	$y = 1.259x - 7.634$	0.995
R04	R04	04/11/2022	$y = 1.157x - 2.287$	0.995
R05	R05	03/11/2022	$y = 1.273x - 8.311$	0.999
R06	R06	01/11/2022	$y = 1.297x - 8.271$	0.999
R07	R07	02/11/2022	$y = 1.071x + 1.468$	0.995
R08	R08	01/11/2022	$y = 1.206x - 5.068$	0.997
R09	R09	01/11/2022	$y = 1.252x - 7.084$	0.995
R10	R10	03/11/2022	$y = 1.246x - 5.817$	0.999
R11	R11	03/11/2022	$y = 1.117x - 1.156$	0.998
R12	R12	02/11/2022	$y = 1.351x - 12.068$	0.996
R13	R13	03/11/2022	$y = 1.118x - 0.601$	0.999
R14	R14	03/11/2022	$y = 1.164x - 2.415$	0.996
R15	R15	03/11/2022	$y = 1.134x - 1.793$	0.998
R16	R16	04/11/2022	$y = 1.182x - 4.717$	0.996
R17	R17	07/11/2022	$y = 1.218x - 5.356$	0.998
R18	R18	04/11/2022	$y = 1.233x - 5.977$	0.996
R19	R19	07/11/2022	$y = 1.277x - 7.752$	0.997
R20	R20	04/11/2022	$y = 1.327x - 10.628$	0.997



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High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume PM-10 Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft^3/min)	R^2
R01	R01	02/11/2022	$y = 1.257x - 6.210$	0.998
R02	R02	07/11/2022	$y = 1.240x - 5.054$	0.996
R03	R03	03/11/2022	$y = 1.199x - 4.666$	0.996
R04	R04	04/11/2022	$y = 1.215x - 6.193$	0.999
R05	R05	04/11/2022	$y = 1.210x - 5.386$	0.998
R06	R06	02/11/2022	$y = 1.270x - 6.263$	0.995
R07	R07	07/11/2022	$y = 1.227x - 5.259$	0.998
R08	R08	03/11/2022	$y = 1.258x - 7.271$	0.998
R09	R09	07/11/2022	$y = 1.202x - 6.317$	0.999
R10	R10	03/11/2022	$y = 1.196x - 4.622$	0.997
R11	R11	02/11/2022	$y = 1.284x - 7.142$	0.996
R12	R12	02/11/2022	$y = 1.253x - 7.460$	0.996
R13	R13	04/11/2022	$y = 1.262x - 6.240$	0.998
R14	R14	04/11/2022	$y = 1.254x - 6.659$	0.999
R15	R15	03/11/2022	$y = 1.299x - 9.065$	0.998
R16	R16	09/11/2022	$y = 1.263x - 7.053$	0.995
R17	R17	07/11/2022	$y = 1.224x - 4.966$	0.997
R18	R18	07/11/2022	$y = 1.235x - 5.907$	0.999
R19	R19	03/11/2022	$y = 1.302x - 9.454$	0.995
R20	R20	04/11/2022	$y = 1.244x - 8.211$	0.999



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CALIBRATION REPORT

SO₂ FLUORESCENT ANALYZER

DATE : 20 November 2022

BRAND : API

MODEL : 100E

NO. SO₂-R03

SERIAL NO. 3488

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO₂)

Cylinder No. : A00814SK

Certified Date : 21 June 2021

Expired Date : 21 June 2029

Cylinder Conc. : 50.0 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
SO ₂ Span	400.0	399.8	-0.050	400.0	1.010

API Model 100E SO₂ Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.6	in-Hg	25-35
SAMPLE FLOW	655	cc/min	650 ± 10%
PMT	103.2	mV	-20-150 with Zero Air
UV LAMP	3015.4	mV	1000-4900
STR. LGT	61.3	PPB	<100
DRK PMT	62.8	mV	-50 - 200
DRK LMP	57.7	mV	-50 - 200
HVPS	669	V	550-900 constant
DCPS	2520	mV	2500 ± 200
RCELL TEMP	50.4	°C	50 ± 1
BOX TEMP	29.1	°C	5-40
PMT TEMP	7.0	°C	7 ± 2.0
SO ₂ Span Conc	400	PPB	20-20,000
SO ₂ Slope	1.010	-	1.0 ± 0.3
SO ₂ Offset	21.7	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

Calibrated by :



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 20 November 2022

BRAND : API

MODEL : 200E

NO. NOX-R06

SERIAL NO. 4466

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 04 August 2022	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)	Cylinder No.	: D636192
Certified Date	: 20 April 2022	Expired Date	: 20 April 2024
		Cylinder Conc.	: 49.1 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar Temp. 24.6 °C % RH 48

CALIBRATION SETTING

Span Set Point	Initial Reading (Before Adj.), PPB			Final Reading (After Adj.), PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
NO Span	400	399.8	-0.050	400.0	1.003
NO _x Span	400	400.1	0.025	400.0	1.007

API Model 200E NO_x Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	510	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.2	mV	-20 - 150
AZERO	94.0	mV	-20 - 150
HVPS	673	V	420 - 900 constant
RCELL TEMP	50.4	°C	50 ± 1
BOX TEMP	29.3	°C	8 - 48
PMT TEMP	7.1	°C	7 ± 2
MOLY TEMP	314.9	°C	315 ± 5
RCELL PRESS	8.5	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.7	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO _x Span Conc	400	PPB	20 - 20,000
NO Slope	1.003	-	1.0 ± 0.3
NO _x Slope	1.007	-	1.0 ± 0.3
NO Offset	1.2	mV	-20 to +150
NO _x Offset	0.8	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

SERIAL No : 1126422905


ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

EQUIPMENT	:	DIGITAL BALANCE	MODEL	:	XS 105DU
MANUFACTURER	:	METTLER TOLEDO	S/N	:	1126422905
ID No	:	BA 05/50	RECEIVED DATE	:	11-Mar-22
AIR PRESSURE	:	1008mbar \pm 1mbar	CALIBRATION DATE	:	11-Mar-22
AMBIENT TEMPERATURE	:	22° C \pm 1° C	RELATIVE HUMIDITY	:	49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	C02210415	09-Feb-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

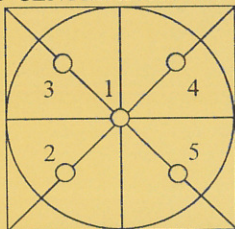
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g
5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000058
0.02	0.01999	0.00001	0.000058
0.10	0.09999	0.00001	0.000059
0.20	0.19999	0.00001	0.000059
0.50	0.50001	-0.00001	0.000058
1.00	1.00001	-0.00001	0.000059
2.00	2.00000	0.00000	0.000059
5.00	5.00001	-0.00001	0.000061
10.00	10.00005	-0.00005	0.000063
20.00	20.00006	-0.00006	0.000069
50.00	50.0000	0.0000	0.00011
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

6. OFF CENTER LOADING ERROR



POINT	READING (g)	
1	10.00001	50.0000
2	10.00002	50.0000
3	10.00001	50.0000
4	10.00001	50.0000
5	10.00002	50.0001
OFF-CENTER LOADING	0.00001	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT PRODUCTION AREA
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

คุณภาพอากาศจากปล่อง



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Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	y	$\Delta H_{@}$ (mmH ₂ O)
B01	1563	01/09/2022	1.004	50.11
B02	8002514	02/09/2022	1.006	49.25
B03	1503016	05/09/2022	1.008	50.30
B04	00006659	05/09/2022	1.005	47.45
B05	00007428	01/09/2022	1.002	49.96
R01	1561	02/09/2022	1.003	49.86
R02	8002513	05/09/2022	1.006	50.09
R03	1570	05/09/2022	1.004	49.23
R04	8002519	01/09/2022	1.005	49.17
R05	1503015	01/09/2022	0.996	49.68

Remark : Accept Value of y (test) is $0.97 < y < 1.03$

Accept Value of $\Delta H_{@}$ (test) is 46.7 ± 6.4 (mmH₂O)



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Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B36	S	0.99	02/11/2022	0.83	0.84
B37	S	0.99	01/11/2022	0.84	0.83
B38	S	0.99	02/11/2022	0.84	0.85
B39	S	0.99	04/11/2022	0.84	0.84
B40	S	0.99	02/11/2022	0.85	0.84
B41	S	0.99	02/11/2022	0.84	0.85
B44	S	0.99	02/11/2022	0.84	0.83
B45	S	0.99	01/11/2022	0.84	0.83
B46	S	0.99	01/11/2022	0.84	0.85
B47	S	0.99	03/11/2022	0.84	0.84
B48	S	0.99	03/11/2022	0.83	0.84
B49	S	0.99	04/11/2022	0.85	0.84
B54	S	0.99	01/11/2022	0.83	0.84
B56	S	0.99	01/11/2022	0.84	0.85
B57	S	0.99	04/11/2022	0.85	0.84
B58	S	0.99	04/11/2022	0.84	0.84

Remark : Accept value of Cp (test) is 0.84 ± 0.01

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-1]
CLID. NO. : 212201112
JOB CONTROL NO. : 220720073201

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 20 July 2022

DATE OF ISSUED : 22 July 2022

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sittipong Pimdee
Calibration Engineer

Approved By :

Authorized Signatory
22 July 2022



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q22073201

F3-011-04/01-12

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@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : **VACUUM GAUGE**
MANUFACTURER : **HI-LIGHT**
MODEL / TYPE : **N/A**
SERIAL NO. : **N/A[64-220066-1]**
DATE OF CALIBRATION : **21 July 2022**

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$

Relative Humidity : $(55 \pm 10) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPPP-05** according to **DKD-R 6-1** as calibration guidelines.

The calibration was performed by direct measurement with Document Process Calibrator and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 744 S/N. 9226007 with Pressure Module Model 700PV4 S/N. 19298401.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).
Certificate No. MP-0196-21, Due Date 17 November 2022.

UNCERTAINTY :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of $k = 2$. It has been evaluated according to the "Calibration of Pressure Gauges (DKD-R 6-1)" which provides a level of confidence approximately 95%.

Certificate No. **Q22073201**

F3-011-04/01-12

page 2 of 3



@clccalibration



CLC
Accredited
ISO/IEC 17025

CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The DUC was exercised by applying a known pressure from its zero to full scale 1 times. Then 2 series of known gauge pressure were applied. The STD reading were recorded and the means value were reported in the table below.

CALIBRATION DATA

CORRECTION OF PRESSURE

DUC Test point (inHg)	STD Reading (inHg)		Correction (inHg)	
	Up	Down	Up	Down
0	0.0	0.0	0.0	0.0
-5	-4.6	-4.7	+0.4	+0.3
-10	-9.5	-9.6	+0.5	+0.4
-15	-14.4	-14.5	+0.6	+0.5
-20	-19.4	-19.5	+0.6	+0.5
-25	-24.5	-24.5	+0.5	+0.5
-30	-29.5	-29.5	+0.5	+0.5

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. k factor 1 kPa = 0.2952998 inHg

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 36 of 54

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q22073201

F3-011-04/01-12

page 3 of 3



@clccalibration



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chaluchak, Bangkok 10900
Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com., www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}\text{C}$
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B41	SKC	224-PCXR4	612669	05/10/2022	1,000	1,500	2,000	998	1,496	1,990	0.994x + 3.271	1.000
B42	SKC	224-PCXR4	626041	06/10/2022	1,000	1,500	2,000	1,005	1,498	1,994	0.988x + 15.619	1.000
B43	SKC	224-PCXR4	034636	06/10/2022	1,000	1,500	2,000	999	1,501	1,992	0.991x + 10.565	1.000
B44	SKC	224-PCXR8	529341	06/10/2022	1,000	1,500	2,000	1,002	1,502	2,002	1.011x - 21.418	0.999
B45	SKC	224-PCXR8	529594	06/10/2022	1,000	1,500	2,000	998	1,498	1,989	0.993x + 5.959	1.000
B46	SKC	224-PCXR8	566743	06/10/2022	1,000	1,500	2,000	994	1,504	2,002	1.016x - 32.885	0.999
B47	SKC	224-PCXR8	566747	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.960	0.999
B48	SKC	224-PCXR8	566753	03/10/2022	1,000	1,500	2,000	999	1,494	1,998	0.999x - 2.114	1.000
B49	SKC	224-PCXR8	566780	05/10/2022	1,000	1,500	2,000	1,003	1,502	2,003	1.012x - 22.706	0.999
B50	SKC	224-PCXR8	500400	06/10/2022	1,000	1,500	2,000	1,001	1,495	2,002	1.001x - 3.737	1.000
B51	SKC	224-PCXR8	500363	06/10/2022	1,000	1,500	2,000	995	1,504	1,999	1.011x - 25.590	0.999
B52	SKC	224-PCXR8	093186	03/10/2022	1,000	1,500	2,000	995	1,496	1,994	0.997x - 1.161	1.000
B53	SKC	224-PCXR8	707670	03/10/2022	1,000	1,500	2,000	1,002	1,500	2,002	1.010x - 20.668	0.999
B54	SKC	224-PCXR3	509821	03/10/2022	1,000	1,500	2,000	993	1,500	2,001	1.017x - 34.516	0.999
B55	SKC	224-PCXR3	510710	03/10/2022	1,000	1,500	2,000	999	1,494	1,994	0.995x + 2.521	1.000
B56	SKC	224-PCXR3	511450	03/10/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.004x - 7.562	1.000
B57	SKC	224-PCXR3	510798	06/10/2022	1,000	1,500	2,000	997	1,492	1,998	0.996x +1.109	1.000
B58	SKC	224-PCXR3	509852	06/10/2022	1,000	1,500	2,000	1,000	1,498	1,999	1.007x - 19.113	0.999
B59	SKC	224-PCXR3	509862	03/10/2022	1,000	1,500	2,000	996	1,503	1,994	0.997x + 2.955	1.000
B60	SKC	224-PCXR3	512655	03/10/2022	1,000	1,500	2,000	1,005	1,500	2,003	1.010x - 19.862	0.999
B61	SKC	224-PCXR3	503915	04/10/2022	1,000	1,500	2,000	994	1,489	1,998	1.004x - 11.786	1.000
B62	SKC	224-PCXR3	505975	03/10/2022	1,000	1,500	2,000	999	1,494	1,996	0.997x - 0.064	1.000
B63	SKC	224-PCXR3	511432	03/10/2022	1,000	1,500	2,000	991	1,501	1,999	1.017x - 35.461	0.999
B64	SKC	224-PCXR3	508302	03/10/2022	1,000	1,500	2,000	997	1,492	1,989	0.992x + 6.266	1.000
B65	SKC	224-PCXR3	508310	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,003	1.011x - 21.992	0.999
B66	SKC	224-PCXR3	509861	06/10/2022	1,000	1,500	2,000	1,002	1,491	1,991	0.988x + 13.904	1.000
B67	SKC	224-PCXR3	506295	06/10/2022	1,000	1,500	2,000	993	1,508	2,004	1.017x - 32.785	0.999
B68	SKC	224-PCXR3	505872	05/10/2022	1,000	1,500	2,000	1,002	1,491	1,997	0.994x + 5.237	1.000
B69	SKC	224-PCXR3	508375	05/10/2022	1,000	1,500	2,000	1,001	1,499	2,000	1.010x - 21.330	0.999
B70	SKC	224-PCXR3	510623	05/10/2022	1,000	1,500	2,000	992	1,503	1,997	1.002x - 6.054	1.000
B71	SKC	224-PCXR3	508367	05/10/2022	1,000	1,500	2,000	990	1,506	2,002	1.018x - 37.025	0.999
B72	SKC	224-PCXR3	505977	05/10/2022	1,000	1,500	2,000	1,001	1,498	1,993	0.993x + 5.731	1.000
B73	SKC	224-PCXR3	512606	05/10/2022	1,000	1,500	2,000	1,001	1,501	2,005	1.014x - 24.397	0.999
B74	SKC	224-PCXR3	505993	05/10/2022	1,000	1,500	2,000	996	1,495	1,994	0.999x - 4.284	1.000
B75	SKC	224-PCXR3	509820	05/10/2022	1,000	1,500	2,000	996	1,498	1,990	0.995x + 2.987	1.000
B76	SKC	224-PCXR3	509811	03/10/2022	1,000	1,500	2,000	993	1,498	1,998	1.006x - 14.003	1.000
B77	SKC	224-PCXR3	508301	06/10/2022	1,000	1,500	2,000	1,000	1,501	2,003	1.014x - 25.845	0.999
B78	SKC	224-PCXR3	510677	06/10/2022	1,000	1,500	2,000	996	1,503	1,999	1.012x - 27.321	0.999
B79	SKC	224-PCXR3	510920	06/10/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x - 3.905	1.000



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Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com. www.spscon.com

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-R01	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	502.9	992.8	1978.7	0.999x + 3.447	0.999
H-R02	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	500.8	995.3	1985.7	1.002x - 5.358	1.000
H-R03	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	502.1	987.7	1996.9	0.994x + 1.850	1.000
H-R04	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	496.0	989.6	2019.5	1.007x - 11.659	1.000
H-R05	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	497.2	988.1	1988.1	1.004x - 9.026	1.000
H-R06	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	505.6	992.4	1979.8	0.999x - 2.422	0.999

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

SERIAL No : 1126422905

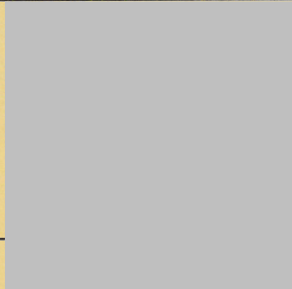
ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	C02210415	09-Feb-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

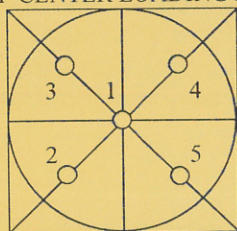
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g
5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000058
0.02	0.01999	0.00001	0.000058
0.10	0.09999	0.00001	0.000059
0.20	0.19999	0.00001	0.000059
0.50	0.50001	-0.00001	0.000058
1.00	1.00001	-0.00001	0.000059
2.00	2.00000	0.00000	0.000059
5.00	5.00001	-0.00001	0.000061
10.00	10.00005	-0.00005	0.000063
20.00	20.00006	-0.00006	0.000069
50.00	50.00000	0.00000	0.000111
100.00	100.00001	-0.00001	0.00019
120.00	120.00001	-0.00001	0.00022

6. OFF CENTER LOADING ERROR



POINT	READING (g)	
1	10.00001	50.0000
2	10.00002	50.0000
3	10.00001	50.0000
4	10.00001	50.0000
5	10.00002	50.00001
OFF-CENTER LOADING	0.00001	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT PRODUCTION AREA
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP22018

Pages 1 of 3

Calibration Certificate

Equipment : UV-VIS SPECTROPHOTOMETER
Manufacturer : PERKINELMER
Model : LAMBDA 25
Serial No.: 501S14123010
ID No.: SP03/58
Calibration Mode : WAVELENGTH ACCURACY
PHOTOMETRIC ACCURACY

Condition As Found : GOOD

Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,
CHOMPHON, CHATUCHAK,
BANGKOK 10900, THAILAND.

Location : ORGANIC LABORATORY IV

Ambient Temperature : (24.4 ± 5) °C
Relative Humidity : (60.1 ± 25) %

Received Date : 30 AUGUST 2022
Calibration Date : 30 AUGUST 2022
Date of Issue : 31 AUGUST 2022

Calibrated by :

Nathakorn Pisutpaisan

Approved by :



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

Continuation of Calibration Certificate

Cert. No. : SP22018

Job No. : VC65SP0008

Pages : 2 of 3

Calibration Method :

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01

The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution

The calibration procedure used was based on ASTM E275-01,ASTM E925-02

Condition of this result of calibration :

1. Certified reference materials

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-1N2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology,NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

Material	Certified Values of Reference Material (nm)	UUC* Reading (nm)	Error (nm)	Uncertainty ± (nm)	k Factor
RM-HL	278.13	278.3	0.17	0.16	2.00
	361.25	361.4	0.15	0.16	2.00
	467.82	467.8	-0.02	0.16	2.00
	536.56	536.5	-0.06	0.16	2.00
	640.50	640.5	0.00	0.16	2.00
RM-DL	740.09	740.0	-0.09	0.16	2.00
	864.94	865.2	0.26	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP22018

Job No. : VC65SP0008

Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

Material	Wavelength (nm)	Filter: S/N	Nominal Absorbance (A)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0524	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
		29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
	590.0	29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
		29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
		29914	0.7	0.6912	0.6902	-0.0010	0.0029	2.00
		29381	0.5	0.5214	0.5210	-0.0004	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810	235.0	20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
		60	0.7453	0.7388	-0.0065	0.0067	2.00	
		80	0.9920	0.9839	-0.0081	0.0071	2.00	
		100	1.2487	1.2414	-0.0073	0.0073	2.00	

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S141230

Resolution of Wavelength Mode 0.1 nm

Resolution of Photometric Mode 0.0001 A

Parameter Setting

Measurement Mode Wavelength, Absorbance

Wavelength Scan 1100 nm-190 nm

Scanning Speed 7.5 nm/min

Data Pitch 0.1 nm

Band width(Wavelength) 1.0 nm

Band width(Vis) 1.0 nm

Band width(Uv) 1.0 nm

Stray Light** UUC* Reading at 220 nm

Transmission T(%)

Absorbance(A)

0.0107

3.9886

**Specific Acceptance :

Transmission ≤ 1.0 T(%), Absorbance ≥ 2.0 A

**Stray light not TISI Accredited

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

End of Calibration Certificate



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Calibration Report					
Non-Dispersive Infrared CO Analyzer					
Date :	04 November 2022	Brand :	API	Model :	300E
No.	CO-R02			Serial No.	171-S
Calibrator (Dilution System)					
Brand : API			Model : 700		
Last Cal. Date : 06 September 2022			Serial No. : 421		
Reference Standard Gas					
Standard Gas : Carbon Monoxide (CO)			Cylinder No. : D196045		
Certified Date : 16 April 2022		Expired Date : 15 April 2024		Cylinder Conc. : 4,570 ppm	
Calibrating Condition					
Pressure : 1011 mmbar		Temp. : 24.6 °C		% RH : 49	
Calibration Setting					
Span	Initial Reading (Before Adj.), PPM			Final Reading (After Adj.), PPM	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	
Zero	0	-0.10	-	0	
CO Span	40.00	40.02	0.050	40.00	
API Model 300E CO Analyzer Check List					
Parameter	Observed Value	Units	Nominal Range		
Range	50	PPM	0-1000 ppm		
Stability	0.10	PPM	< 1 ppm With Zero Air		
CO Measure	4014.3	mV	2500-4800 mV		
CO Reference	3949.6	mV	2500-4800 mV		
Measure/Reference Ratio	1.179	-	1.1-1.3 W/Zero Air		
Sample Pressure	28.5	In-Hg-A	~2" < Ambient Absolute Pressure		
Sample Flow	808	CC/Min	800 ± 10%		
Sample Temperature	48.3	°C	48 ± 4		
Bench Temperature	48.2	°C	48 ± 2		
Wheel Temperature	68.5	°C	68 ± 2		
Box Temperature	30.8	°C	Ambient Temp + 7 ± 10		
Photo-Drive	3028.1	mV	250 mV to 4750 mV		
Slope	1.016	-	1.0 ± 0.3		
Offset	0.2	-	0 ± 0.3		



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>July 11, 2022</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>January 11, 2023</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>January 12, 2022</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>1 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>August 30, 2022</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>November 30, 2022</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>August 30, 2022</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED July 11, 2022**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

B. Inspect and replace as necessary, all torch components including the RF coil.

C. Inspect all tubing for sign of clacking or leaking.

D. Adjust water and gas pressure regulator settings.

E. Inspect and leak check pneumatics drawers.

F. Clean the exterior of the instrument.

2. OPTICAL CHECKS

A. Inspect and clean all optical components.

B. As required, check and replace all purgefilters.

C. Recheck optical alignment.

3. COOLING SYSTEM CHECKS

A. Perform preventive maintenance on chiller.

B. Flush out the chiller every year.

4. PERFORMANCE CHECKS

A. Torch View Alignment.

B. Wavelength Calibration.



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : July 11, 2022

PARAMETER	SPECIFICATION			FINAL VALUE
Spectral Resolution : UV	As 193.696 nm	≤ 0.007		<u>0.00544</u>
	Ni 231.604 nm	≤ 0.008		<u>0.00709</u>
	Ni 341.476 nm	≤ 0.012		<u>0.00757</u>
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020		<u>0.01638</u>
	Ba 455.403 nm	≤ 0.025		<u>0.02391</u>
Precision				
	As 193.656 nm	% RSD < 1.0		<u>0.91</u> %
	Zn 213.856 nm	% RSD < 1.0		<u>0.87</u> %
	Mn 257.610 nm	% RSD < 1.0		<u>0.76</u> %
	La 379.478 nm	% RSD < 1.0		<u>0.59</u> %
	Ba 455.403 nm	% RSD < 1.0		<u>0.53</u> %
	Ba 493.408 nm	% RSD < 1.0		<u>0.55</u> %
Detection Limits : Axial	Tl 190.080 nm	3(sd)		<u>5.51</u> ppb
	As 193.696 nm	3(sd)		<u>8.59</u> ppb
	Pb 220.353 nm	3(sd)		<u>0.50</u> ppb
Detection Limits : Radial	As 193.696 nm	3(sd)		<u>2.17</u> ppb
	Zn 213.856 nm	3(sd)		<u>0.03</u> ppb
	Mn 257.610 nm	3(sd)		<u>0.01</u> ppb
	La 379.478 nm	3(sd)		<u>0.04</u> ppb
	Ba 455.403 nm	3(sd)		<u>0.01</u> ppb
	Ba 493.408 nm	3(sd)		<u>0.00</u> ppb
BEC : Axial (IB X 500)/(IS-IB)	Cd 226.502 nm	≤ 150 ppb		<u>12.46</u>
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 45 ppb		<u>30.82</u>



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 11, 2022**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested

☒

meets

☐

does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,
including warranty terms.


Service Department PerkinElmer Ltd.

Authorized Representative: _____



PinAAcle 900Z Preventive Maintenance (PM)

Company Name:	S.P.S.CONSULTING SERVICE CO.,LTD.		
Address (Instrument Location):	PHAHOLYOTHIN RD, JOMPON, BANGKOK, 51, TH, 10900		
Serial Number:	PZAS19090402	PM Number:	1/2
Customer Name (if applicable):	K. PHENPHA	Telephone Number:	083-926-9252
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-01473846
Date PM Performed: (DD-MMM-YYYY)	01-Jun-2022	Next PM Due Date: (DD-MMM-YYYY)	01-Dec-2022
Standard Labor Hours to Complete PM :		5 hours	

Part Number	Release	Publication Date	
09370144 Rev.9	A	January 2018	

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900Z by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM.

Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files.

The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer.

Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes
AS900	AS9419052359	Syngistix 3.1

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	2
B3002013	THGA Contact Cylinders	1
B3141064	Glycerol for THGA Cooling	N/A

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300244	GFAAS Mixed Standard	AR	56-021CRY1	30-Jun-2023

Additional Reagents and Standards Required for PM (Customer Support Solution)				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR	AR
N/A	0.5% HNO ₃	250 ml.	AR	AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
B3100652 Or N9307029	Electronic Flow Meter	1	NA
B0505495	Test Jig	1	NA
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190
N3050119	Cr Lumina HCL	1	091911-020150

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Perform general inspection of system for cleanliness.

2. PC Instrument Software:

- ☒ Instrument Software user files/databases archived, packed, and/or deleted as needed.

3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector, P/N 09921079, if needed.
- ☒ Clean exterior of the instrument.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed, P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease, P/N 09905148
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function.
- ☒ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ☒ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ☒ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ☒ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN
- ☒ Perform Cooling System maintenance if needed per SDB# COSY005.STN.
- ☒ Check auto sampler operation.
- ☒ Perform an auto sampler check valve test as described in the Service Manual.
- ☒ Lubricate the spindles of the auto sampler pumps and all moving parts of the tray mechanics as described in the Service Manual.
- ☒ Inspect the auto sampler sampling capillary as described in the Service Manual. Replace if necessary.
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function

4. Electrical:

- ☒ Inspect PC boards. Clean if necessary.
- ☒ Check instrument firmware revisions upgrade to current levels (if necessary)
- ☒ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

- ☒ Inspect and clean the sample compartment windows, if needed.
- ☒ Inspect and clean the furnace windows, if needed.
- ☒ Inspect and clean the GFTV camera lens, if needed.
- ☒ Inspect optics. Clean or replace if necessary,

6. Gasses:

- ☒ Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-installation Checklist SDB.
- ☒ Verify that the air filter element is dry. Replace if necessary.

7. After PM Performance tests [THGA]:

7.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min \pm 25 mL/min	255	Passed
External Flow Rate	100 mL/min \pm 10 mL/min	105	Passed

7.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	\leq 0.005 Abs.	0.0001	Passed
Standard Deviation	\leq 0.005	0.0002	Passed

7.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

Parameter	Specification	Results	Pass/Fail
Cr m_0 Results	\leq 7.0 pg/0.0044 A-s	5.6	Passed
Precision	\leq 2.0 %	0.56	Passed

7.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

Parameter	Specification	Results	Pass/Fail
Cu m ₀ Result	≤ 16.5 pg/0.0044 A-s	14.1	Passed
Zeeman Ratio	0.52 ± 0.04	0.53	Passed

8. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM	
Zeeman Ratio	$= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$ $= \frac{0.1609}{0.1609 + 0.1377}$ $= 0.53$
REPLACE PM KIT FOR PinAAcle900Z	

Review

<i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900Z have been completed.</i>		
<i>This PinAAcle 900Z Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i>		
Review of Preventive Maintenance:		
Authorized PerkinElmer Representative:	<div style="background-color: #cccccc; width: 100%; height: 80px;"></div>	Date: 01-Jun-2022 <small>(DD-MMM-YYYY)</small>
Authorized Customer Representative:	<div style="background-color: #cccccc; width: 100%; height: 80px;"></div>	Date: 01-Jun-2022 <small>(DD-MMM-YYYY)</small>

คุณภาพน้ำ

DATA SHEET FOR CALIBRATION / VERIFICATION AND INSPECTION


Calibration

Verification

Inspection
เครื่องมือ / อุปกรณ์ ที่สอบเทียบหรือทวนสอบ

Equipment / Tools : Multimeter (pH , DO) Tag No. / I.D. No. : L09-AT-SP003-A2 Serial No. : 130500088588

Cal. / Ver. date : 4/4/2022
เครื่องมือ / อุปกรณ์ที่เป็น Master

Equipment / Tools :	I.D. No.	Model /Serial No.	Cert. No.	Expired date

Reference Materials ที่ใช้

Chemical	Grade	Assay (%)	Cert. No.	Expired date
Buffer pH 4.00 ; Lot No. HC99677935				31/7/2022
Buffer pH 7.00 ; Lot No. HC04269139				31/10/2023
Buffer pH 10.00 ; Lot No. HC02905338				30/6/2023

Calibration / verification item	Result	Error	Acceptance Criteria	Pass / Fail
1.การสอบเทียบ Observed Slope (slope)	98	-	95 to 105%	Pass
2.verification pH6.86	6.85	-0.01	± 0.05	Pass

Inspection item	Result	Correction
1.ตรวจเช็คสภาพพร้อมใช้งาน	ปกติ	

Next Due date 31/5/2022

Performed by :

:

Date :

: 4/4/2022

Approved By :

:

Date :

: 4/4/2022

Certificate of Analysis – Certified Reference Material

Certipur® Buffer solution pH 10.00 (20°C)

Certified Reference Material for pH measurement

Product no.: 1.09438.1000
Lot no.: HC02905338
Description of CRM: Certipur® Buffer solution pH 10.00 (20°C)
Certified Reference Material for pH measurement
Expiry date: 2023/06/30
Storage: +15°C to +25°C tightly closed in the original container
Composition: boric acid / potassium chloride / sodium hydroxide



Certified value

Associated uncertainty, $U=k \cdot u$
($k=2$)

pH value 10.01

 ± 0.03 (20°C)

Metrological traceability:

The pH value of this certified buffer solution is directly traceable to primary certified reference materials characterised by PTB and verified by SRMs from NIST.

NIST 189c, 188, 185i, 186 Ig, 186 IIg, 187f
PTB OX-405/18, TA-442/19, PHT-340/16, PHO-346/16, BO-373/17
PTB: Physikalisch Technische Bundesanstalt, Braunschweig, Germany
NIST: National Institute of Standards and Technology, Gaithersburg, USA.

Measurement method:

pH value is measured with a combined glass electrode after 5-point calibration according to DIN 19268 with reference buffer solutions according to DIN 19266, IUPAC, NIST, Ph.Eur. and USP.

Accreditation:

Merck KGaA, Darmstadt, Germany is accredited by the German accreditation authority DAkkS as registered reference material producer D-RM-15185-01-00 in accordance with ISO 17034 and registered calibration laboratory D-K-15185-01-00 according to DIN EN ISO/IEC 17025.

Certificate issue date:

2020/06/24



ISO 17034



ISO/IEC 17025



CRM released by Approving Officer
or delegate LS-OII-QS3

Dipl.-Ing. Ayfer Yildirim
Responsible Manager of LS-OII-QS3
(Calibration Laboratory D-K-15185-01)



Intended use:	This reference material is intended for use as a calibration standard for pH instruments or pH electrodes or as a control sample for measuring the pH value.
Instructions for handling and correct use:	The pH value is strongly dependent on the temperature. It is therefore necessary to keep the temperature constant within the measurement.
Health and safety information:	Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.
Preparation:	This reference material is prepared gravimetrically from boric acid, potassium chloride, sodium hydroxide and high purity water.

Associated uncertainty:

The expanded uncertainty U_{CRM} is calculated as $U_{CRM} = k \cdot u_{CRM}$, where $k = 2$ is the coverage factor for a 95% coverage probability and u_{CRM} is the combined standard uncertainty in accordance to ISO 17034.

The combined uncertainty u_{CRM} is derived from combination of the squared uncertainty contributions:

$$u_{CRM} = \sqrt{u^2_{Characterisation} + u^2_{Homogeneity} + u^2_{Stability}}$$

$u_{characterisation}$:	is the uncertainty in accordance with DIN EN ISO/IEC 17025 which includes the contributions of the primary reference material and the measuring system.
$u_{homogeneity}$:	is the between-bottle variation in accordance with ISO 17034. The assessment of homogeneity is performed by analysis of a representative number of systematically chosen sample units.
$u_{stability}$:	is the uncertainty obtained from short-term and long-term stability in accordance with ISO 17034. The stability studies are the basis for the quantification of the expiry date of this reference material for the unopened bottle.

Informative values:

Temperature dependence ¹ :	Temperature [°C]	Δ pH
	0	+ 0.26
	5	+ 0.17
	10	+ 0.11
	15	+ 0.05
	20	± 0
	25	- 0.06
	30	- 0.11
	35	- 0.16
	40	- 0.18
	50	- 0.26

¹Temperature deviation data provided for reference only. Values are not batch-specific and should not be considered certified values.

For more detailed information please read the certification report on our website.

Certificate of analysis revision history:

Certificate version	Date	Reason for version
01	2020/06/24	Initial version





Certificate of Calibration

Equipment: pH METER
Model: HQ40d
Serial No. (or ID.): 130500088588 (201000002308)
Manufacturer: Hach
Electrode Serial No.: 210362614404
Condition: In Condition

Certificate No.: C07220217
Issued Date: 27 April 2022
Job No.: KSPR2205346
Page: 1 of 3
Model: PHC201
Brand: Hach

Customer: IRPC PUBLIC CO., LTD.
299 Moo 5, Sukhumvit Road, Tambol Choengneon,
Amphur Muang, Rayong 21000 Thailand

Environment Condition: Temperature 25.7 °C ± 0.8 °C
Humidity 66.5 %RH ± 2.4 %RH

Calibration Place: IRPC PUBLIC CO., LTD.(Gc Lab 207)
299 Moo 5, Sukhumvit Road, Tambol Choengneon,
Amphur Muang, Rayong 21000 Thailand

Calibration By: Mr. Dumrong Boonsopon

Calibration Date: 27 April 2022

The Method used: In house method, SPCC-WI-58, base on ASTM E 70-07

Traceability: This certificate is traceable to SI Units, Sample Test is assured through primary measurement method Harned cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 794132, 794134, 794133 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20210028EA



(Mr. Dumrong Boonsopon)

Person in charge



(Mr. Thalerngkeat Pounngnam)

Authorized signatory

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

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

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

Calibration Results:**pH Scale**

Input	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	Error (mV)	(pH)		
414.12	414.0	-0.12	-	0.065	2.00
354.96	354.8	-0.16	0.999	0.065	2.00
295.8	295.7	-0.10	1.999	0.065	2.00
236.64	236.6	-0.04	2.999	0.065	2.00
177.48	177.4	-0.08	4.000	0.065	2.00
118.32	118.3	-0.02	5.000	0.065	2.00
59.16	59.1	-0.06	6.000	0.065	2.00
0	0.0	0.00	7.000	0.065	2.00
-59.16	-59.2	-0.04	8.000	0.065	2.00
-118.32	-118.3	0.02	9.000	0.065	2.00
-177.48	-177.5	-0.02	10.000	0.065	2.00
-236.64	-236.6	0.04	11.001	0.065	2.00
-295.8	-295.7	0.10	12.001	0.065	2.00
-354.96	-354.9	0.06	13.002	0.065	2.00
-414.12	-414.0	0.12	-	0.065	2.00

Electrode Test Results*

The three-point calibration using three standard buffer solutions; pH 4.008 , pH 6.985 and pH 10.015

The practical slope of the pH electrode; 58.09 (mV/pH), 98.19%

The zero point of the pH electrode; 6.70 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	4.008	0.000	0.012	2.43
6.985	6.998	0.013	0.0097	2.05
10.015	10.023	0.008	0.013	2.00

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

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2205346

ชนิดเครื่องมือ: pH METER

รุ่น: HQ40d

หมายเลขเครื่อง: 130500088588

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

เพิ่มเติม/ข้อแนะนำ : Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ 25.0 \pm 0.5°C

Mr. Dumrong Boonsopon
Service Engineer

ระดับเสียงในบรรยากาศ

Certificate No.: CP20220335EA

Operation No.: CP2022100023

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: RION

Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)

Serial No.: 00546401 (Meter), 152917 (Microphone), 46612 (Preamplifier)

ID No.: -

Customer: IRPC Public Company Limited.

Address: 299 Moo 5, Sukhumvit Rd., Tumbon Chungnern,
Amphor Muang, Rayong 21000

Received Date: 25 October 2022

Calibrated Date: 2 - 7 November 2022

Issued Date: 16 November 2022

Calibrated by: Ms. Juntaporn Kunhakom

Approved by:

Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20220335EA

Calibration Report

Equipment: Sound Level Meter
 Manufacturer: RION
 Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)
 Serial No.: 00546401 (Meter), 152917 (Microphone), 46612 (Preamplifier)
 ID No.: -
 Ambient Temperature: (23 ± 2) °C
 Relative Humidity: (50 ± 15) %
 Pressure: (101.3 ± 1.5) kPa
 Method of Calibration :-
 IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1020-22	14 June 2023
2) Arbitrary Function Generator	AFG2021	C010063	CK20220059EA	19 June 2023
3) Programmable Attenuator	PA5	2913	EF-0014-22	3 April 2023
4) 6.5 Digit precision multimeter	8846A	9610014	CB20220223EA	14 November 2023
5) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 CD20220164EA	17 March 2023 24 July 2023
6) Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P220029 CD20220165EA	31 March 2023 24 July 2023
7) Performance Audio Analyzer	U8903B	MY56510003	CB20220063EA CK20220080EA	15 February 2023 8 September 2023

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
94.1	94.1	0.0	±1.0

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34536113.

Certificate No.: CP20220335EA

Calibration Report

Equipment: Sound Level Meter
 Manufacturer: RION
 Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)
 Serial No.: 00546401 (Meter), 152917 (Microphone), 46612 (Preamplifier)
 ID No.: -
 Ambient Temperature: (23 ± 2) °C
 Relative Humidity: (50 ± 15) %
 Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

	Instrument	Model	Serial No.	Cert. No.	Due Date
1)	Standard microphone	4180	2661000	AA-1020-22	14 June 2023
2)	Arbitrary Function Generator	AFG2021	C010063	CK20220059EA	19 June 2023
3)	Programmable Attenuator	PA5	2913	EF-0014-22	3 April 2023
4)	6.5 Digit precision multimeter	8846A	9610014	CB20220223EA	14 November 2023
5)	Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 CD20220164EA	17 March 2023 24 July 2023
6)	Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P220029 CD20220165EA	31 March 2023 24 July 2023
7)	Performance Audio Analyzer	U8903B	MY56510003	CB20220063EA CK20220080EA	15 February 2023 8 September 2023

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
94.1	94.1	0.0	±1.0

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34536113.

Certificate No.: CP20220335EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
15.4

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	11.3
C-weighting	17.1
Z-weighting	23.2

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

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

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.7	0.7	0.8	±1.5
1000	0.2	0.2	0.2	±1.0
8000	-2.4	-2.3	-2.4	±5.0

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	0.0	-0.1	0.0	±2.0
125	0.0	-0.1	0.0	±1.5
250	0.0	-0.1	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.1	0.1	0.0	±5.0

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

Certificate No.: CP20220335EA

Calibration Report

5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.3

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±1.1
99.0	99.0	0.0	±1.1
104.0	104.0	0.0	±1.1
109.0	109.0	0.0	±1.1
114.0	114.0	0.0	±1.1
119.0	119.0	0.0	±1.1
124.0	124.0	0.0	±1.1
129.0	129.0	0.0	±1.1
130.0	130.0	0.0	±1.1
131.0	131.0	0.0	±1.1
132.0	132.0	0.0	±1.1
133.0	133.0	0.0	±1.1
134.0	134.0	0.0	±1.1
135.0	135.0	0.0	±1.1
136.0	136.0	0.0	±1.1
137.0	137.0	0.0	±1.1

7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
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

Certificate No.: CP20220335EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower (Cont.)

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	33.8	-0.2	±1.1
29.0	28.9	-0.1	±1.1

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	126.0	0.0	±1.0
	2	109.0	0.0	+1.0 ; -2.5
	0.25	99.9	-0.1	+1.5 ; -5.0
Slow	200	119.6	0.0	±1.0
	2	100.0	0.0	+1.0 ; -5.0
LAE	200	120.0	0.0	±1.0
	2	100.0	0.0	+1.0 ; -2.5
	0.25	90.9	-0.1	+1.5 ; -5.0

Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	125.4	125.2	-0.2	±3.0
Positive half cycle	124.4	124.1	-0.3	±2.0
Negative half cycle	124.4	124.1	-0.3	±2.0

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.5	139.6	0.1	±1.5

Certificate No.: CP20220335EA

Calibration Report

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	129.0	129.0	0.0	±0.3

Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 2.
3. The coverage factor $k = 2.00$

-- End of Report --

Certificate No.: CP20220336EA

Operation No.: CP2022100024

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: RION

Model/Type: NL-52 (Meter), UC-59 (Microphone), NH-25 (Preamplifier)

Serial No.: 00632063 (Meter), 05230 (Microphone), 32091 (Preamplifier)

ID No.: -

Customer: IRPC Public Company Limited.

Address: 299 Moo 5, Sukhumvit Rd., Tumbon Chungnern,
Amphor Muang, Rayong 21000

Received Date: 25 October 2022

Calibrated Date: 2 - 7 November 2022

Issued Date: 16 November 2022

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: _____

Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20220336EA

Calibration Report

Equipment: Sound Level Meter
 Manufacturer: RION
 Model/Type: NL-52 (Meter), UC-59 (Microphone), NH-25 (Preamplifier)
 Serial No.: 00632063 (Meter), 05230 (Microphone), 32091 (Preamplifier)
 ID No.: -
 Ambient Temperature: (23 ± 2) °C
 Relative Humidity: (50 ± 15) %
 Pressure: (101.3 ± 1.5) kPa
 Method of Calibration :-
 IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

	Instrument	Model	Serial No.	Cert. No.	Due Date
1)	Standard microphone	4180	2661000	AA-1020-22	14 June 2023
2)	Arbitrary Function Generator	AFG2021	C010063	CK20220059EA	19 June 2023
3)	Programmable Attenuator	PA5	2913	EF-0014-22	3 April 2023
4)	6.5 Digit precision multimeter	8846A	9610014	CB20220223EA	14 November 2023
5)	Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 CD20220164EA	17 March 2023 24 July 2023
6)	Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P220029 CD20220165EA	31 March 2023 24 July 2023
7)	Performance Audio Analyzer	U8903B	MY56510003	CB20220063EA CK20220080EA	15 February 2023 8 September 2023

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

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

- Reference standards instrument for Acoustic function
 - National Institute of Metrology (Thailand)
- Reference standards instrument for Electrical function
 - National Institute of Metrology (Thailand)
 - Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
94.1	94.1	0.0	±0.7

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34536113.

Certificate No.: CP20220336EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
15.3

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	9.9
C-weighting	15.4
Z-weighting	21.5

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

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

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.1	0.1	0.1	±1.0
1000	0.2	0.2	0.2	±0.7
8000	-0.6	-0.6	-0.7	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	0.1	0.0	0.0	±1.0
125	0.0	-0.1	0.0	±1.0
250	0.0	-0.1	0.0	±1.0
500	0.0	-0.1	0.0	±1.0
1000	0.0	0.0	0.0	±0.7
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.0	+1.5; -2.5
16000	-1.4	-1.4	0.0	+2.5; -16.0

Certificate No.: CP20220336EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.1

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
99.0	99.0	0.0	±0.8
104.0	104.0	0.0	±0.8
109.0	109.0	0.0	±0.8
114.0	114.0	0.0	±0.8
119.0	119.0	0.0	±0.8
124.0	124.0	0.0	±0.8
129.0	129.0	0.0	±0.8
130.0	130.0	0.0	±0.8
131.0	131.0	0.0	±0.8
132.0	132.0	0.0	±0.8
133.0	133.0	0.0	±0.8
134.0	134.0	0.0	±0.8
135.0	135.0	0.0	±0.8
136.0	136.0	0.0	±0.8
137.0	137.0	0.0	±0.8

Certificate No.: CP20220336EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
29.0	28.9	-0.1	±0.8

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	126.0	0.0	±0.5
	2	109.0	0.0	+1.0 ; -1.5
	0.25	99.9	-0.1	+1.0 ; -3.0
Slow	200	119.6	0.0	±0.5
	2	100.0	0.0	+1.0 ; -3.0
	0.25	91.0	0.0	+1.0 ; -3.0

Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	125.4	125.3	-0.1	±2.0
Positive half cycle	124.4	124.0	-0.4	±1.0
Negative half cycle	124.4	124.0	-0.4	±1.0

Certificate No.: CP20220336EA

Calibration Report

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.4	139.4	0.0	±1.5

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	129.0	129.0	0.0	±0.1

Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 1.
3. The coverage factor $k = 2.00$

- - End of Report - -

ระดับเสียงในสถานประกอบการ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co.,Ltd.

Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was 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 : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

The results relate only to the items tested/calibrated 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.

FM.BL.MTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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 20 μ Pa at 1000 Hz

Acoustic Output in dB re 20 μ Pa, 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	93.93	-0.07	± 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	999.9	-0.1	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.44	± 0.50	$\pm 3.0\%$

- Note :
1. No adjustment.
 2. The calibrator pressure correction was not included.
 3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : 2011265042601787001

2 / 2

End of Certificate

The results relate only to the items tested/calibrated or value assigned.

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FM.BL.MTC.002 Rev.4

ระดับเสียงติดตัวบุคคล

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co.,Ltd.

Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was 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 : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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FM.BL.MTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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 20 μ Pa at 1000 Hz

Acoustic Output in dB re 20 μ Pa, 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 Bruel&Kjaer 4180	93.93	-0.07	± 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 Bruel&Kjaer 4180	999.9	-0.1	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.44	± 0.50	$\pm 3.0\%$

- Note :
1. No adjustment.
 2. The calibrator pressure correction was not included.
 3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : 2011265042601787001

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End of Certificate

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FM.BL.MTC.002 Rev.4

คุณภาพอากาศในสถานประกอบการ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chaluchak, Bangkok 10900

Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 °C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
R01	SKC	224-PCXR4	602467	01/07/2022	1,000	1,500	2,000	993	1,508	2,004	1.020x - 38.744	0.998
R02	SKC	224-PCXR4	626450	01/07/2022	1,000	2,000	3,000	998	1,499	1,990	0.989x + 12.348	1.000
R03	SKC	224-PCXR4	691592	04/07/2022	1,000	1,500	2,000	1,003	1,500	2,004	1.012x - 22.080	0.999
R04	SKC	224-PCXR4	691672	01/07/2022	1,000	1,500	2,000	996	1,493	1,993	0.997x - 1.763	1.000
R05	SKC	224-PCXR4	798470	04/07/2022	1,000	1,500	2,000	994	1,506	1,999	1.013x - 30.077	0.999
R06	SKC	224-PCXR4	798456	04/07/2022	1,000	1,500	2,000	994	1,498	1,994	1.002x - 7.319	1.000
R07	SKC	224-PCXR4	798480	04/07/2022	1,000	1,500	2,000	994	1,490	2,000	1.008x - 17.031	1.000
R08	SKC	224-PCXR4	883215	05/07/2022	1,000	1,500	2,000	1,001	1,502	2,005	1.015x - 26.148	0.999
R09	SKC	224-PCXR4	034650	01/07/2022	1,000	1,500	2,000	991	1,504	2,002	1.018x - 36.777	0.999
R10	SKC	224-PCXR4	091765	04/07/2022	1,000	1,500	2,000	996	1,512	1,994	1.000x + 0.100	1.000
R11	SKC	224-PCXR4	091763	01/07/2022	1,000	1,500	2,000	1,000	1,499	2,002	1.013x - 25.598	0.999
R12	SKC	224-PCXR4	091568	04/07/2022	1,000	1,500	2,000	997	1,501	1,999	1.001x - 4.866	1.000
R13	SKC	224-PCXR4	091638	04/07/2022	1,000	1,500	2,000	1,002	1,498	1,993	0.991x + 10.115	1.000
R14	SKC	224-PCXR4	091764	04/07/2022	1,000	1,500	2,000	994	1,502	1,999	1.013x - 29.654	0.999
R15	SKC	224-PCXR8	529457	01/07/2022	1,000	1,500	2,000	1,001	1,500	2,004	1.013x - 25.263	0.999
R16	SKC	224-PCXR8	529643	01/07/2022	1,000	1,500	2,000	998	1,497	1,994	0.997x - 0.379	1.000
R17	SKC	224-PCXR8	529645	01/07/2022	1,000	1,500	2,000	994	1,509	2,000	1.014x - 30.173	0.999
R18	SKC	224-PCXR8	566756	04/07/2022	1,000	1,500	2,000	991	1,496	1,998	1.001x - 6.880	1.000
R19	SKC	224-PCXR8	566802	01/07/2022	1,000	1,500	2,000	1,003	1,499	2,000	1.010x - 19.831	0.999
R20	SKC	224-PCXR8	529089	01/07/2022	1,000	1,500	2,000	990	1,500	2,003	1.020x - 40.235	0.999
R21	SKC	224-PCXR8	665728	04/07/2022	1,000	1,500	2,000	998	1,493	1,999	1.001x - 5.604	1.000
R22	SKC	224-PCXR8	707444	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.011x - 21.494	0.999
R23	SKC	224-PCXR8	761067	04/07/2022	1,000	1,500	2,000	998	1,494	1,992	0.994x + 2.896	1.000
R24	SKC	224-PCXR8	707893	01/07/2022	1,000	1,500	2,000	996	1,505	2,000	1.013x - 27.843	0.999
R25	SKC	224-PCXR8	761052	04/07/2022	1,000	1,500	2,000	998	1,500	1,993	0.993x + 6.633	1.000
R26	SKC	224-PCXR8	707956	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.298	0.999
R27	SKC	224-PCXR8	707398	01/07/2022	1,000	1,500	2,000	996	1,503	2,001	1.013x - 28.844	0.999
R28	SKC	224-PCXR8	707481	04/07/2022	1,000	1,500	2,000	1,004	1,500	2,003	1.010x - 19.727	0.999
R29	SKC	224-PCXR8	707402	01/07/2022	1,000	1,500	2,000	1,005	1,491	1,991	0.988x + 13.928	1.000
R30	SKC	224-PCXR8	093811	01/07/2022	1,000	1,500	2,000	998	1,495	1,994	0.998x - 1.149	1.000
R31	SKC	224-PCXR8	093183	01/07/2022	1,000	1,500	2,000	1,001	1,501	2,001	1.012x - 23.161	0.999
R32	SKC	224-PCXR8	671950	04/07/2022	1,000	1,500	2,000	1,000	1,498	1,994	0.993x + 7.961	1.000
R33	SKC	224-PCXR4	626254	04/07/2022	1,000	1,500	2,000	992	1,502	1,999	1.017x - 34.540	0.999
R34	SKC	224-PCXR4	626131	04/07/2022	1,000	1,500	2,000	1,002	1,498	2,004	1.013x - 25.091	0.999
R35	SKC	224-PCXR8	707460	04/07/2022	1,000	1,500	2,000	998	1,498	1,995	0.994x + 5.472	1.000
R36	SKC	224-PCXR8	707446	01/07/2022	1,000	1,500	2,000	1,003	1,500	2,001	1.009x - 19.272	0.999
R37	SKC	224-PCXR8	707432	01/07/2022	1,000	1,500	2,000	999	1,499	1,998	0.998x + 0.243	1.000
R38	SKC	224-PCXR8	707349	01/07/2022	1,000	1,500	2,000	996	1,500	2,002	1.015x - 32.039	0.999
R39	SKC	224-PCXR8	761095	04/07/2022	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.333	1.000



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com.. www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
R01	SKC	224-PCXR4	602467	06/10/2022	1,000	1,500	2,000	993	1,508	2,004	1.020x - 38.145	0.999
R02	SKC	224-PCXR4	626450	06/10/2022	1,000	2,000	3,000	998	1,499	1,990	0.989x + 12.189	1.000
R03	SKC	224-PCXR4	691592	03/10/2022	1,000	1,500	2,000	1,004	1,500	2,004	1.011x - 21.482	0.999
R04	SKC	224-PCXR4	691672	03/10/2022	1,000	1,500	2,000	996	1,493	1,994	0.997x - 0.766	1.000
R05	SKC	224-PCXR4	798470	06/10/2022	1,000	1,500	2,000	994	1,505	1,999	1.014x - 30.635	0.999
R06	SKC	224-PCXR4	798456	06/10/2022	1,000	1,500	2,000	994	1,498	1,994	1.002x - 7.000	1.000
R07	SKC	224-PCXR4	798480	06/10/2022	1,000	1,500	2,000	994	1,490	1,999	1.008x - 16.751	1.000
R08	SKC	224-PCXR4	883215	06/10/2022	1,000	1,500	2,000	1,001	1,501	2,005	1.014x - 26.148	0.999
R09	SKC	224-PCXR4	034650	06/10/2022	1,000	1,500	2,000	991	1,504	2,002	1.018x - 36.179	0.999
R10	SKC	224-PCXR4	091765	06/10/2022	1,000	1,500	2,000	996	1,512	1,994	1.000x + 0.140	1.000
R11	SKC	224-PCXR4	091763	06/10/2022	1,000	1,500	2,000	1,000	1,499	2,002	1.013x - 25.678	0.999
R12	SKC	224-PCXR4	091568	06/10/2022	1,000	1,500	2,000	997	1,501	1,999	1.001x - 5.065	1.000
R13	SKC	224-PCXR4	091638	06/10/2022	1,000	1,500	2,000	1,002	1,499	1,994	0.992x + 9.636	1.000
R14	SKC	224-PCXR4	091764	06/10/2022	1,000	1,500	2,000	994	1,502	1,999	1.014x - 30.053	0.999
R15	SKC	224-PCXR8	529457	06/10/2022	1,000	1,500	2,000	1,001	1,500	2,004	1.013x - 25.023	0.999
R16	SKC	224-PCXR8	529643	06/10/2022	1,000	1,500	2,000	998	1,497	1,994	0.998x - 1.017	1.000
R17	SKC	224-PCXR8	529645	06/10/2022	1,000	1,500	2,000	994	1,509	2,000	1.015x - 30.372	0.999
R18	SKC	224-PCXR8	566756	06/10/2022	1,000	1,500	2,000	991	1,498	1,998	1.001x - 6.880	1.000
R19	SKC	224-PCXR8	566802	06/10/2022	1,000	1,500	2,000	1,003	1,499	2,000	1.009x - 19.751	0.999
R20	SKC	224-PCXR8	529089	06/10/2022	1,000	1,500	2,000	990	1,501	2,003	1.020x - 40.195	0.999
R21	SKC	224-PCXR8	665728	06/10/2022	1,000	1,500	2,000	998	1,493	1,999	1.001x - 6.003	1.000
R22	SKC	224-PCXR8	707444	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,002	1.011x - 21.733	0.999
R23	SKC	224-PCXR8	761067	06/10/2022	1,000	1,500	2,000	998	1,494	1,991	0.993x + 36535	1.000
R24	SKC	224-PCXR8	707893	06/10/2022	1,000	1,500	2,000	996	1,505	2,000	1.013x - 27.803	0.999
R25	SKC	224-PCXR8	761052	05/10/2022	1,000	1,500	2,000	998	1,499	1,993	0.993x + 6.713	1.000
R26	SKC	224-PCXR8	707956	05/10/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.058	0.999
R27	SKC	224-PCXR8	707398	05/10/2022	1,000	1,500	2,000	996	1,503	2,001	1.006x - 15.683	1.000
R28	SKC	224-PCXR8	707481	05/10/2022	1,000	1,500	2,000	1,004	1,500	2,003	1.010x - 19.687	0.999
R29	SKC	224-PCXR8	707402	05/10/2022	1,000	1,500	2,000	1,005	1,493	1,991	0.988x + 14.366	1.000
R30	SKC	224-PCXR8	093811	05/10/2022	1,000	1,500	2,000	999	1,495	1,994	0.997x - 0.8069	1.000
R31	SKC	224-PCXR8	093183	06/10/2022	1,000	1,500	2,000	1,001	1,501	2,001	1.012x - 22.523	0.999
R32	SKC	224-PCXR8	671950	06/10/2022	1,000	1,500	2,000	1,000	1,498	1,994	0.994x + 8.041	1.000
R33	SKC	224-PCXR4	626254	06/10/2022	1,000	1,500	2,000	993	1,502	1,999	1.016x - 33.303	0.999
R34	SKC	224-PCXR4	626131	06/10/2022	1,000	1,500	2,000	1,002	1,498	2,004	1.013x - 24.453	0.999
R35	SKC	224-PCXR8	707460	06/10/2022	1,000	1,500	2,000	999	1,498	1,995	0.994x + 6.709	1.000
R36	SKC	224-PCXR8	707446	06/10/2022	1,000	1,500	2,000	1,003	1,499	2,001	1.009x - 19.432	0.999
R37	SKC	224-PCXR8	707432	06/10/2022	1,000	1,500	2,000	997	1,499	1,998	0.998x + 0.116	1.000
R38	SKC	224-PCXR8	707349	05/10/2022	1,000	1,500	2,000	996	1,500	2,002	1.015x - 31.640	0.999
R39	SKC	224-PCXR8	761095	05/10/2022	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.094	1.000



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chaluchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
L-R01	Dwyer	VFA-21	04/07/2022	50	100	200	50.2	101.0	203.5	0.988x + 2.342	1.000
L-R02	Dwyer	VFA-21	04/07/2022	50	100	200	50.1	101.3	200.5	1.006x - 0.768	0.999
L-R03	Dwyer	VFA-21	04/07/2022	50	100	200	50.5	99.8	202.3	1.016x - 0.811	1.000
L-R04	Dwyer	VFA-21	01/07/2022	50	100	200	50.2	100.9	200.6	1.009x - 1.208	0.999
L-R05	Dwyer	VFA-21	01/07/2022	50	100	200	50.2	100.4	203.0	0.991x + 1.666	1.000
L-R06	Dwyer	VFA-21	04/07/2022	50	100	200	50.6	99.1	201.5	1.002x - 0.007	1.000



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0822/20530

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

Organization : S.P.S. Consulting Service Co., Ltd.

Address : 7 Phahonyothin Soi 24 Phahonyothin Rd. Ladyao Chatuchak Bangkok 10900

Date : 10/08/2022

ELECTRONIC TEST

CPU	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
LCD TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
VENT TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
KEY ECHO TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
DESTRUCTION RAM TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

Column	80 °C hold 1 min., rate 20 °C/min. to 200 °C hold 1min.
Injector	220 °C
Detector	300 °C
Column flow	5 mL/min
Makeup flow	25 mL/min
Air flow	300 mL/min
Hydrogen flow	30 mL/min

Column:Capillary Column CP sil 5 CB 0.25 ID x 15 M

Sample: 1 µL Injection FID Test Sample 0.218 g/L C14,C15,C16 in hexane

SENSITIVITY TEST: C15. (Area count) = 118,103 Counts.





Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (μ V)	2.94	≤ 50
Baseline Drift (%)	0.18	≤ 1
Sensitivity (S/N for C15)	4,000	$\geq 1,024$

Temperature Specification

Temperature	Set	Result	Specification
Column Oven ($^{\circ}$ C)	80	80	± 5
Injector ($^{\circ}$ C)	220	220	± 5
Detector ($^{\circ}$ C)	300	300	± 5
Incubator ($^{\circ}$ C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	1.68	≤ 5
Retention Time C15(%)	0.01	≤ 0.5

APPROVAL

Signature: 

Engineer : Suwarot Trikainut

Date : 10/08/2022





บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	117,172
C15 Area 2	119,182
C15 Area 3	117,982
C15 Area 4	118,589
C15 Area 5	117,592
C15 Area Average	118,103
* % RSD (< 5 %)	1.68

* The precision specification should be less than 2.0 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 5 % for Manual injections. To calculate the %RSD, select the C15 peak area for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by		
Date		



Comments			
Reviewed by			
		Date	10/08/2022



VARIAN



Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 RT 1	4.048
C15 RT 2	4.048
C15 RT 3	4.048
C15 RT 4	4.048
C15 RT 5	4.048
C15 RT Average	4.000
* % RSD (< 0.5 %)	0.01

* The precision specification should be less than 0.5 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 0.5 % for Manual injections. To calculate the %RSD, select the RT C15 peak for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by		
Date		



Comments			
Reviewed by		Date	10/08/2022

