ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือ

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
1. คุณภาพอากาศในบรรยากาศ		
Sulfur Dioxide	SO_2 Analyzer No. R03, R04, R05, R07, R08, R09, R10	SO_2 Analyzer No. R03, R04, R05, R07, R08, R09, R10
Nitrogen Dioxide	$NO/NO_2/NO_x$ Analyzer No. R02, R03, R05, R06, R07, R08, R09, R10	$NO/NO_2/NO_x$ Analyzer No. R02, R03, R05, R06, R07, R08, R09, R10
Total Hydrocarbon	Personal Pump SKC No. B01, R01, R02 Rotameter No. L-R01, R06	THC Analyzer No. B01, R01, R02, R03
2. คุณภาพอากาศจากแหล่งกำเนิด		
Total Suspended Particulate	Console No. R03 Pitot Tube No. B38	Digital Balance
Oxides of Nitrogen	Vacuum Gauge	Spectrophotometer
Sulfur Dioxide	Personal Pump SKC No. R05, R06, R08, R48 Rotameter No. H-R03	-
Carbon Monoxide	Personal Pump SKC No. R06, R08 Rotameter No. H-R03	CO Analyzer No. R01
Lead	Console No. R03 Pitot Tube No. B38	ICP
Mercury	Console No. R03 Pitot Tube No. B38	AAS
3. คุณภาพน้ำ		
pH	-	pH Meter
Temperature	-	Thermometer
BOD_5	-	BOD Analyzer
Total Suspended Solids (TSS)	-	Digital Balance
Grease & Oil	-	Digital Balance
4. ระดับเสียงทั่วไป		
L_{eq} 24 hr และ L_{max}	Acoustic Calibrator Sound Level Meter No. ACO-R32	-
5. ระดับเสียงในสถานประกอบการ		
L_{eq} 8 hr, L_{max} และ TWA	Acoustic Calibrator Sound Level Meter ACO No. B03	-
6. ปริมาณเสียงสะสมแบบติดตัวบุคคล		
Noise Dose	Acoustic Calibrator Sound Level Meter ACO No. R52	-

คุณภาพอากาศในบรรยากาศ

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

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	11 February 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R08			SERIAL NO.	243

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	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.	24.4	°C	% RH	49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.10	-	0	-
NO Span	400	400.1	0.025	400.0	1.009
NO_X Span	400	400.3	0.075	400.0	1.012

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	509	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	102.9	mV	-20 - 150
AZERO	93.7	mV	-20 - 150
HVPS	669	V	420 - 900 constant
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.3	°C	8 - 48
PMT TEMP	7.0	°C	7 ± 2
MOLY TEMP	315.3	°C	315 ± 5
RCELL PRESS	8.2	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.5	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	1.009	-	1.0 ± 0.3
NO_X Slope	1.012	-	1.0 ± 0.3
NO Offset	1.6	mV	-20 to +150
NO_X Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2

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

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	11 February 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R09			SERIAL NO.	252

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	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. 24.4	°C	% RH 49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
NO Span	400	399.7	-0.075	400.0	1.004
NO_X Span	400	399.9	-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	506	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	103.3	mV	-20 - 150
AZERO	94.1	mV	-20 - 150
HVPS	673	V	420 - 900 constant
RCELL TEMP	50.3	°C	50 ± 1
BOX TEMP	29.4	°C	8 - 48
PMT TEMP	7.1	°C	7 ± 2
MOLY TEMP	314.9	°C	315 ± 5
RCELL PRESS	8.3	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.6	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	1.004	-	1.0 ± 0.3
NO_X Slope	1.007	-	1.0 ± 0.3
NO Offset	1.1	mV	-20 to +150
NO_X Offset	0.7	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

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
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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	11 February 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R10			SERIAL NO.	1991

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	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. 24.4	°C	% RH 49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
NO Span	400	399.8	-0.050	400.0	1.007
NO_X Span	400	400.2	0.050	400.0	1.010

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	512	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.1	mV	-20 - 150
AZERO	93.9	mV	-20 - 150
HVPS	670	V	420 - 900 constant
RCELL TEMP	50.4	^{o}C	50 ± 1
BOX TEMP	29.1	^{o}C	8 - 48
PMT TEMP	7.2	^{o}C	7 ± 2
MOLY TEMP	315.2	^{o}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	1.007	-	1.0 ± 0.3
NO_X Slope	1.010	-	1.0 ± 0.3
NO Offset	1.5	mV	-20 to +150
NO_X Offset	0.9	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2

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

SO_2 FLUORESCENT ANALYZER

DATE :	11 February 2024	BRAND :	API	MODEL :	100E
NO.	SO_2-R03			SERIAL NO.	3488

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.4 °C	% RH	49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
SO_2 Span	400.0	400.1	0.025	400.0	1.012

API Model 100E SO_2 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	659	cc/min	650 ± 10%
PMT	103.2	mV	-20-150 with Zero Air
UV LAMP	3027.5	mV	1000-4900
STR. LGT	61.5	PPB	<100
DRK PMT	63	mV	-50 - 200
DRK LMP	57.7	mV	-50 - 200
HVPS	671	V	550-900 constant
DCPS	2521	mV	2500 ± 200
RCELL TEMP	50.3	°C	50 ± 1
BOX TEMP	29.1	°C	5-40
PMT TEMP	7.2	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.012	-	1.0 ± 0.3
SO_2 Offset	21.9	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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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, Chatuchak, Bangkok 10900
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CALIBRATION REPORT

SO_2 FLUORESCENT ANALYZER

DATE :	11 February 2024	BRAND :	API	MODEL :	100E
NO.	SO_2-R09			SERIAL NO.	76

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.4 °C	% RH	49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.10	-	0	-
SO_2 Span	400.0	399.8	-0.050	400.0	1.009

API Model 100E SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.7	in-Hg	25-35
SAMPLE FLOW	654	cc/min	650 ± 10%
PMT	103.1	mV	-20-150 with Zero Air
UV LAMP	3017.8	mV	1000-4900
STR. LGT	61.7	PPB	<100
DRK PMT	63.3	mV	-50 - 200
DRK LMP	57.9	mV	-50 - 200
HVPS	674	V	550-900 constant
DCPS	2523	mV	2500 ± 200
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.3	°C	5-40
PMT TEMP	7.4	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.009	-	1.0 ± 0.3
SO_2 Offset	22.1	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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

CALIBRATION REPORT

SO_2 FLUORESCENT ANALYZER

DATE :	11 February 2024	BRAND :	TELEDYNE	MODEL :	100E
NO.	SO_2-R10			SERIAL NO.	TRS1065

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011	mmbar	Temp.	24.4 °C	% RH	49

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	-0.10	-	0	-
SO_2 Span	400.0	399.7	-0.075	400.0	1.006

API Model 100E SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.5	in-Hg	25-35
SAMPLE FLOW	656	cc/min	650 ± 10%
PMT	103.0	mV	-20-150 with Zero Air
UV LAMP	3010.2	mV	1000-4900
STR. LGT	61.8	PPB	<100
DRK PMT	63.2	mV	-50 - 200
DRK LMP	58.1	mV	-50 - 200
HVPS	670	V	550-900 constant
DCPS	2528	mV	2500 ± 200
RCELL TEMP	50.5	°C	50 ± 1
BOX TEMP	29.4	°C	5-40
PMT TEMP	7.3	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.006	-	1.0 ± 0.3
SO_2 Offset	21.8	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H | S/N : 136164

Environmental Conditions

Temperature	. 25	± 3	°C
Pressure	. 1010	± 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
R01	SKC	224-PCXR4	602467	03/01/2024	1,000	1,500	2,000	992	1,508	2,005	1.008x – 15.012	1.000
R02	SKC	224-PCXR4	626450	04/01/2024	1,000	2,000	3,000	998	1,499	1,990	0.989x + 12.189	1.000
R03	SKC	224-PCXR4	691592	03/01/2024	1,000	1,500	2,000	1,004	1,500	2,004	1.012x – 22.718	0.999
R04	SKC	224-PCXR4	691672	04/01/2024	1,000	1,500	2,000	996	1,493	1,996	0.998x – 2.002	1.000
R05	SKC	224-PCXR4	798470	03/01/2024	1,000	1,500	2,000	993	1,507	1,999	1.013x – 29.199	0.999
R06	SKC	224-PCXR4	798456	04/01/2024	1,000	1,500	2,000	997	1,498	1,996	1.002x – 6.760	1.000
R07	SKC	224-PCXR4	798480	05/01/2024	1,000	1,500	2,000	994	1,492	1,999	1.008x – 16.153	1.000
R08	SKC	224-PCXR4	883215	05/01/2024	1,000	1,500	2,000	1,012	1,500	2,005	0.999x + 3.725	1.000
R09	SKC	224-PCXR4	034650	05/01/2024	1,000	1,500	2,000	991	1,504	2,001	1.018x – 36.179	0.999
R10	SKC	224-PCXR4	091765	03/01/2024	1,000	1,500	2,000	997	1,511	1,994	1.000x + 0.499	1.000
R11	SKC	224-PCXR4	091763	04/01/2024	1,000	1,500	2,000	1,000	1,499	2,002	1.012x – 24.042	0.999
R12	SKC	224-PCXR4	091568	03/01/2024	1,000	1,500	2,000	996	1,500	2,000	1.003x – 7.698	1.000
R13	SKC	224-PCXR4	091638	04/01/2024	1,000	1,500	2,000	1,002	1,501	1,991	0.989x + 14.781	1.000
R14	SKC	224-PCXR4	091764	03/01/2024	1,000	1,500	2,000	994	1,503	1,999	1.014x – 30.292	0.999
R15	SKC	224-PCXR8	529457	03/01/2024	1,000	1,500	2,000	1,001	1,500	2,004	1.006x – 11.543	1.000
R16	SKC	224-PCXR8	529643	05/01/2024	1,000	1,500	2,000	998	1,495	1,994	0.999x – 3.450	1.000
R17	SKC	224-PCXR8	529645	04/01/2024	1,000	1,500	2,000	995	1,509	2,001	1.015x – 30.890	0.999
R18	SKC	224-PCXR8	566756	04/01/2024	1,000	1,500	2,000	991	1,498	1,998	1.001x – 6.800	1.000
R19	SKC	224-PCXR8	566802	04/01/2024	1,000	1,500	2,000	1,002	1,499	2,000	1.010x – 20.772	0.999
R20	SKC	224-PCXR8	529089	05/01/2024	1,000	1,500	2,000	991	1,500	2,003	1.020x – 39.390	0.999
R21	SKC	224-PCXR8	665728	03/01/2024	1,000	1,500	2,000	998	1,495	1,999	1.000x – 3.937	1.000
R22	SKC	224-PCXR8	707444	03/01/2024	1,000	1,500	2,000	1,003	1,500	2,003	1.005x – 8.595	1.000
R23	SKC	224-PCXR8	761067	03/01/2024	1,000	1,500	2,000	998	1,491	1,991	0.993x + 3.358	1.000
R24	SKC	224-PCXR8	707893	04/01/2024	1,000	1,500	2,000	996	1,508	2,000	1.008x – 16.660	0.999
R25	SKC	224-PCXR8	761052	04/01/2024	1,000	1,500	2,000	1,010	1,496	1,995	0.985x + 21.199	1.000
R26	SKC	224-PCXR8	707956	04/01/2024	1,000	1,500	2,000	1,002	1,500	2,005	1.010x – 16.732	1.000
R27	SKC	224-PCXR8	707398	03/01/2024	1,000	1,500	2,000	996	1,500	2,002	1.007x – 16.201	1.000
R28	SKC	224-PCXR8	707481	05/01/2024	1,000	1,500	2,000	1,004	1,501	2,002	1.010x – 19.878	0.999
R29	SKC	224-PCXR8	707402	05/01/2024	1,000	1,500	2,000	1,003	1,494	1,989	0.986x + 16.137	1.000
R30	SKC	224-PCXR8	093811	05/01/2024	1,000	1,500	2,000	1,000	1,493	1,993	0.995x + 4.371	1.000
R31	SKC	224-PCXR8	093183	05/01/2024	1,000	1,500	2,000	1,001	1,501	2,000	1.002x – 2.800	1.000
R32	SKC	224-PCXR8	671950	05/01/2024	1,000	1,500	2,000	998	1,501	1,993	0.996x + 4.136	1.000
R33	SKC	224-PCXR4	626254	03/01/2024	1,000	1,500	2,000	994	1,502	2,000	1.015x – 32.298	0.999
R34	SKC	224-PCXR4	626131	03/01/2024	1,000	1,500	2,000	1,002	1,499	2,004	1.007x – 12.157	1.000
R35	SKC	224-PCXR8	707460	04/01/2024	1,000	1,500	2,000	999	1,498	1,995	0.994x + 6.098	1.000
R36	SKC	224-PCXR8	707446	04/01/2024	1,000	1,500	2,000	1,004	1,498	2,001	1.009x – 18.630	0.999
R37	SKC	224-PCXR8	707432	04/01/2024	1,000	1,500	2,000	996	1,499	2,000	1.000x – 1.827	1.000
R38	SKC	224-PCXR8	707349	03/01/2024	1,000	1,500	2,000	997	1,500	2,002	1.003x – 7.889	1.000

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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

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	03/01/2024	50	100	200	50.8	101.0	204.3	0.982x + 3.092	0.999
L-R02	Dwyer	VFA-21	04/01/2024	50	100	200	50.1	102.0	201.4	1.006x – 0.301	0.999
L-R03	Dwyer	VFA-21	03/01/2024	50	100	200	50.1	100.2	202.3	1.013x – 0.675	1.000
L-R04	Dwyer	VFA-21	03/01/2024	50	100	200	50.2	100.9	201.2	1.007x – 0.709	0.999
L-R05	Dwyer	VFA-21	04/01/2024	50	100	200	50.2	101.0	201.4	0.993x + 1.253	1.000

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CALIBRATION REPORT

Total Hydrocarbon Analyzer

DATE :	11 February 2024	BRAND :	HORIBA	MODEL :	APHA-360CE
NO.	THC-B01			SERIAL NO.	4211954001

Calibrator (Dilution System)

Brand	: Teledyne	Model	: 700E
Last Cal. Date	: 30 October 2023	Serial No.	201-S

Reference Standard Gas

Standard Gas	: Methane (CH_4)	Cylinder No.	: D612165
Certified Date	: 25 February 2023	Expired Date : 25 February 2031	Cylinder Conc. : 453 ppm

Calibrating Condition

Pressure	1011	mmbar	Temp.	24.4	°C	% RH	49
						Start Time :	9:00 AM

Pre-Calibration Checks

Change Particulate Filter	YES	Station Temp :	25.0	^{o}C
Leak Test	YES			

Calibration Setting

Span Set Point	Initial Reading (Befored Adj)		Final Reading (After Adj)
	Expected Concentration (PPM)	Analyzer Response (PPM)	Analyzer Response (PPM)
Zero	0	0.10	0
Span	10	10.04	10

Calibration Setting (Final)

Span Instrument Gain:	0.996	Finish Time:	10:00 AM

APHA-360CE Total Hydrocarbon Analyzer

Test Values	Observed Value	Units	Nominal Range
SIGNAL (CH_4)	912.8	mV	800-1,350
SIGNAL (THC)	917.4	mV	800-1,350
DETECTOR	77.9	kPa	((Pressure air/1013)x100)-20 ± 4 kPa
PURIFIER	19.3	kPa	8 - 25
NMC	259.5	^{o}C	260 ± 10
BYPATH	0.9	L / min	0.9 ± 0.3
OVER FLOW	0.8	L / min	0.8

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

SO_2 FLUORESCENT ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	100E
NO.	SO_2-R04			SERIAL NO.	3489

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011	mmbar	Temp.	24.5	24.5	% RH	49

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	0.10	-	0	-
SO_2 Span	400.0	400.2	0.050	400.0	1.011

API Model 100E SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.7	in-Hg	25-35
SAMPLE FLOW	654	cc/min	650 ± 10%
PMT	103.3	mV	-20-150 with Zero Air
UV LAMP	3034.1	mV	1000-4900
STR. LGT	61.8	PPB	<100
DRK PMT	63.3	mV	-50 - 200
DRK LMP	58.0	mV	-50 - 200
HVPS	671	V	550-900 constant
DCPS	2528	mV	2500 ± 200
RCELL TEMP	50.2	°C	50 ± 1
BOX TEMP	29.3	°C	5-40
PMT TEMP	7.1	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.011	-	1.0 ± 0.3
SO_2 Offset	22.1	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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

SO_2 FLUORESCENT ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	100E
NO.	SO_2-R05			SERIAL NO.	3490

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49

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	-0.10	-	0	-
SO_2 Span	400.0	399.7	-0.075	400.0	1.005

API Model 100E SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.5	in-Hg	25-35
SAMPLE FLOW	659	cc/min	650 ± 10%
PMT	103.0	mV	-20-150 with Zero Air
UV LAMP	3016.4	mV	1000-4900
STR. LGT	61.4	PPB	<100
DRK PMT	62.9	mV	-50 - 200
DRK LMP	57.6	mV	-50 - 200
HVPS	672	V	550-900 constant
DCPS	2517	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	1.005	-	1.0 ± 0.3
SO_2 Offset	21.9	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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

SO_2 FLUORESCENT ANALYZER

DATE :	12 May 2024	BRAND :	TELEDYNE	MODEL :	TML-60
NO.	SO_2-R07			SERIAL NO.	TRS1068

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011	mmbar	Temp.	24.5	°C	% RH	49

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	-
SO_2 Span	400.0	400.3	0.075	400.0	1.014

API Model TML-60 SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.4	in-Hg	25-35
SAMPLE FLOW	653	cc/min	650 ± 10%
PMT	103.1	mV	-20-150 with Zero Air
UV LAMP	3022.5	mV	1000-4900
STR. LGT	61.7	PPB	<100
DRK PMT	63.2	mV	-50 - 200
DRK LMP	57.8	mV	-50 - 200
HVPS	669	V	550-900 constant
DCPS	2524	mV	2500 ± 200
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.0	°C	5-40
PMT TEMP	7.4	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.014	-	1.0 ± 0.3
SO_2 Offset	22.2	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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

SO_2 FLUORESCENT ANALYZER

DATE :	12 May 2024	BRAND :	TELEDYNE	MODEL :	TML-60
NO.	SO_2-R08			SERIAL NO.	TRS1064

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.10	-	0	-
SO_2 Span	400.0	399.8	-0.050	400.0	1.008

API Model TML-60 SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.5	in-Hg	25-35
SAMPLE FLOW	660	cc/min	650 ± 10%
PMT	103.5	mV	-20-150 with Zero Air
UV LAMP	3044.3	mV	1000-4900
STR. LGT	61.5	PPB	<100
DRK PMT	63.0	mV	-50 - 200
DRK LMP	58.1	mV	-50 - 200
HVPS	674	V	550-900 constant
DCPS	2518	mV	2500 ± 200
RCELL TEMP	50.2	°C	50 ± 1
BOX TEMP	29.1	°C	5-40
PMT TEMP	7.3	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.008	-	1.0 ± 0.3
SO_2 Offset	22.0	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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

SO_2 FLUORESCENT ANALYZER

DATE :	12 May 2024	BRAND :	TELEDYNE	MODEL :	100E
NO.	SO_2-R10			SERIAL NO.	TRS1065

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Sulphur Dioxide (SO_2)			Cylinder No.	: A00814SK
Certified Date	: 21 June 2021	Expired Date	: 21 June 2029	Cylinder Conc.	: 49.8 ppm

CALIBRATING CONDITION

Pressure	1011	mmbar	Temp. 24.5	°C	% RH 49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
SO_2 Span	400.0	400.2	0.050	400.0	1.012

API Model 100E SO_2 Analyzer Check list

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	0-500
SAMPLE PRESS	28.7	in-Hg	25-35
SAMPLE FLOW	658	cc/min	650 ± 10%
PMT	102.9	mV	-20-150 with Zero Air
UV LAMP	3011.6	mV	1000-4900
STR. LGT	61.4	PPB	<100
DRK PMT	63.0	mV	-50 - 200
DRK LMP	57.8	mV	-50 - 200
HVPS	669	V	550-900 constant
DCPS	2525	mV	2500 ± 200
RCELL TEMP	50.0	°C	50 ± 1
BOX TEMP	28.8	°C	5-40
PMT TEMP	7.1	°C	7 ± 2.0
SO_2 Span Conc	400	PPB	20-20,000
SO_2 Slope	1.012	-	1.0 ± 0.3
SO_2 Offset	21.9	mV	<250
Stability at Zero	0.1	PPB	<0.2
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)

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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R02			SERIAL NO.	2285

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)			Cylinder No.	: A00726SV
Certified Date	: 05 January 2023	Expired Date	: 05 January 2026	Cylinder Conc.	: 48.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49

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	-0.10	-	0	-
NO Span	400	400.1	0.025	400.0	1.010
NO_X Span	400	400.3	0.075	400.0	1.013

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	511	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.4	mV	-20 - 150
AZERO	94.2	mV	-20 - 150
HVPS	675	V	420 - 900 constant
RCELL TEMP	29.1	°C	50 ± 1
BOX TEMP	28.9	°C	8 - 48
PMT TEMP	7.3	°C	7 ± 2
MOLY TEMP	314.9	°C	315 ± 5
RCELL PRESS	8.2	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.4	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	1.010	-	1.0 ± 0.3
NO_X Slope	1.013	-	1.0 ± 0.3
NO Offset	1.7	mV	-20 to +150
NO_X Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R03			SERIAL NO.	4410

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)			Cylinder No.	: A00726SV
Certified Date	: 05 January 2023	Expired Date	: 05 January 2026	Cylinder Conc.	: 48.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49

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	0.10	-	0	-
NO Span	400	399.7	-0.075	400.0	1.005
NO_X Span	400	399.9	-0.025	400.0	1.009

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	504	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	103.0	mV	-20 - 150
AZERO	93.7	mV	-20 - 150
HVPS	673	V	420 - 900 constant
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.5	°C	8 - 48
PMT TEMP	7.2	°C	7 ± 2
MOLY TEMP	314.8	°C	315 ± 5
RCELL PRESS	8.3	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.6	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	1.005	-	1.0 ± 0.3
NO_X Slope	1.009	-	1.0 ± 0.3
NO Offset	1.4	mV	-20 to +150
NO_X Offset	0.9	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span			

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7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R05			SERIAL NO.	4413

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)			Cylinder No.	: A00726SV
Certified Date	: 05 January 2023	Expired Date	: 05 January 2026	Cylinder Conc.	: 48.8 ppm

CALIBRATING CONDITION

Pressure	1011	mmbar	Temp.	24.5	°C	% RH	49

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	400.1	0.025	400.0	1.008
NO_X Span	400	400.2	0.050	400.0	1.011

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	103.4	mV	-20 - 150
AZERO	94.1	mV	-20 - 150
HVPS	671	V	420 - 900 constant
RCELL TEMP	50.3	°C	50 ± 1
BOX TEMP	29.2	°C	8 - 48
PMT TEMP	7.4	°C	7 ± 2
MOLY TEMP	315.3	°C	315 ± 5
RCELL PRESS	8.4	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	1.008	-	1.0 ± 0.3
NO_X Slope	1.011	-	1.0 ± 0.3
NO Offset	1.6	mV	-20 to +150
NO_X Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	

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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, Chatuchak, Bangkok 10900
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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R06			SERIAL NO.	4466

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)			Cylinder No.	: A00726SV
Certified Date	: 05 January 2023	Expired Date	: 05 January 2026	Cylinder Conc.	: 48.8 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49

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	-0.10	-	0	-
NO Span	400	399.6	-0.100	400.0	1.004
NO_X Span	400	399.8	-0.050	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	507	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	102.9	mV	-20 - 150
AZERO	93.6	mV	-20 - 150
HVPS	669	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	315.1	°C	315 ± 5
RCELL PRESS	8.3	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.4	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	1.004	-	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

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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, Chatuchak, Bangkok 10900
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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO_2 / NO_X ANALYZER

DATE :	12 May 2024	BRAND :	API	MODEL :	200E
NO.	NOX-R07			SERIAL NO.	4468

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)			Cylinder No.	: A00726SV
Certified Date	: 05 January 2023	Expired Date	: 05 January 2026	Cylinder Conc.	: 48.8 ppm

CALIBRATING CONDITION

Pressure	1011	mmbar	Temp.	24.5	°C	% RH	49

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	400.2	0.050	400.0	1.010
NO_X Span	400	400.3	0.075	400.0	1.014

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	512	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.2	mV	-20 - 150
AZERO	94.0	mV	-20 - 150
HVPS	672	V	420 - 900 constant
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.4	°C	8 - 48
PMT TEMP	7.3	°C	7 ± 2
MOLY TEMP	315.2	°C	315 ± 5
RCELL PRESS	8.4	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.6	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	1.100	-	1.0 ± 0.3
NO_X Slope	1.014	-	1.0 ± 0.3
NO Offset	1.8	mV	-20 to +150
NO_X Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	

คุณภาพอากาศจากแหล่งกำเนิด

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S.P.S. CONSULTING SERVICE CO., LTD.
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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Console Calibration Report

Calibration Method	Critical Orifices

Calibration Data				
Console Data		Calibration Data		
No.	Serial No.	Date	y	$\Delta H_@$ (mmH_2O)
B01	1563	01/03/2024	1.003	50.38
B02	8002514	04/03/2024	1.002	49.73
B03	1503016	02/03/2024	0.997	50.45
B04	00006659	01/03/2024	1.004	49.97
B05	00007428	02/03/2024	0.996	49.65
R01	1561	02/03/2024	0.999	50.18
R02	8002513	01/03/2024	1.005	50.04
R03	1570	03/03/2024	0.998	49.82
R04	8002519	02/03/2024	1.004	49.58
R05	1503015	03/03/2024	1.002	50.33

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

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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Pitot Tube Calibration Report

Calibration Method	Standard Pitot Tube

Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficience of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B36	S	0.99	07/05/2024	0.84	0.84
B37	S	0.99	07/05/2024	0.84	0.83
B38	S	0.99	07/05/2024	0.85	0.84
B39	S	0.99	09/05/2024	0.84	0.84
B40	S	0.99	09/05/2024	0.84	0.83
B41	S	0.99	09/05/2024	0.84	0.84
B44	S	0.99	08/05/2024	0.83	0.84
B45	S	0.99	08/05/2024	0.84	0.84
B46	S	0.99	08/05/2024	0.84	0.84
B47	S	0.99	08/05/2024	0.85	0.84
B48	S	0.99	10/05/2024	0.84	0.84
B49	S	0.99	06/05/2024	0.84	0.84
B54	S	0.99	06/05/2024	0.85	0.84
B56	S	0.99	07/05/2024	0.83	0.84
B57	S	0.99	10/05/2024	0.84	0.84
B58	S	0.99	10/05/2024	0.85	0.84

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

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CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2814

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	VACUUM GAUGE
MANUFACTURER	:	HI-LIGHT
MODEL / TYPE	:	N/A
SERIAL NO.	:	N/A[64-220066-3]
CLID. NO.	:	212201114
JOB CONTROL NO.	:	230725081569

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

DATE OF RECEIVED : 25 July 2023 DATE OF ISSUED : 31 July 2023

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

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. Q23081569

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

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CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2814

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	**VACUUM GAUGE**
MANUFACTURER	:	**HI-LIGHT**
MODEL / TYPE	:	**N/A**
SERIAL NO.	:	**N/A[64-220066-3]**
DATE OF CALIBRATION	:	**26 July 2023**
DUE DATE OF CALIBRATION	:	**26 July 2024**

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C **Relative Humidity : (55 ± 10) %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 741B S/N. 8295020 with Pressure Module Model 700PD5 S/N. 89404505.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand). Certificate No. MP-0035-23, Due Date 02 February 2024.

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%.

@clccalibration

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 (kPa)		Conversion to inHg		Correction (inHg)	
	Up	Down	Up	Down	Up	Down
0	0.00	0.00	0.0	0.0	0.0	0.0
-5	-16.66	-16.69	-4.9	-4.9	+0.1	+0.1
-10	-33.79	-33.79	-10.0	-10.0	0.0	0.0
-15	-50.76	-50.76	-15.0	-15.0	0.0	0.0
-20	-67.79	-67.82	-20.0	-20.0	0.0	0.0
-25	-84.68	-84.72	-25.0	-25.0	0.0	0.0
-30	-101.51	-101.51	-30.0	-30.0	0.0	0.0

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. Conversion factor 1 kPa ; 0.2953003 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

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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	± 3	°C
Pressure	.	1010	± 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
R01	SKC	224-PCXR4	602467	04/04/2024	1,000	1,500	2,000	994	1,506	2,006	1.009x – 15.012	1.000
R02	SKC	224-PCXR4	626450	04/04/2024	1,000	2,000	3,000	999	1,497	1,989	0.988x + 13.944	1.000
R03	SKC	224-PCXR4	691592	09/04/2024	1,000	1,500	2,000	1,006	1,498	2,005	1.011x – 20.963	0.999
R04	SKC	224-PCXR4	691672	02/04/2024	1,000	1,500	2,000	998	1,491	1,995	0.996x + 0.630	1.000
R05	SKC	224-PCXR4	798470	04/04/2024	1,000	1,500	2,000	995	1,508	1,998	1.010x – 23.496	0.999
R06	SKC	224-PCXR4	798456	05/04/2024	1,000	1,500	2,000	998	1,500	1,997	1.001x – 5.085	1.000
R07	SKC	224-PCXR4	798480	02/04/2024	1,000	1,500	2,000	996	1,491	2,002	1.009x – 17.230	1.000
R08	SKC	224-PCXR4	883215	04/04/2024	1,000	1,500	2,000	1,010	1,502	2,007	1.001x + 0.255	1.000
R09	SKC	224-PCXR4	034650	05/04/2024	1,000	1,500	2,000	994	1,503	2,003	1.017x – 34.105	0.999
R10	SKC	224-PCXR4	091765	05/04/2024	1,000	1,500	2,000	998	1,497	1,996	1.001x - 3.929	1.000
R11	SKC	224-PCXR4	091763	05/04/2024	1,000	1,500	2,000	1,001	1,501	2,001	1.010x – 21.251	0.999
R12	SKC	224-PCXR4	091568	04/04/2024	1,000	1,500	2,000	997	1,500	2,002	1.004x – 9.014	1.000
R13	SKC	224-PCXR4	091638	08/04/2024	1,000	1,500	2,000	1,003	1,503	1,993	0.990x + 13.944	1.000
R14	SKC	224-PCXR4	091764	09/04/2024	1,000	1,500	2,000	995	1,501	1,998	1.013x – 27.899	0.999
R15	SKC	224-PCXR8	529457	04/04/2024	1,000	1,500	2,000	1,002	1,501	2,003	1.005x – 8.870	1.000
R16	SKC	224-PCXR8	529643	08/04/2024	1,000	1,500	2,000	999	1,497	1,995	1.000x – 4.367	1.000
R17	SKC	224-PCXR8	529645	04/04/2024	1,000	1,500	2,000	997	1,507	2,003	1.012x – 23.233	0.999
R18	SKC	224-PCXR8	566756	08/04/2024	1,000	1,500	2,000	992	1,499	1,999	1.002x – 7.159	1.000
R19	SKC	224-PCXR8	566802	04/04/2024	1,000	1,500	2,000	1,002	1,497	2,002	1.011x – 21.211	0.999
R20	SKC	224-PCXR8	529089	08/04/2024	1,000	1,500	2,000	994	1,501	2,004	1.013x – 24.274	1.000
R21	SKC	224-PCXR8	665728	04/04/2024	1,000	1,500	2,000	1,000	1,496	1,998	0.999x – 1.264	1.000
R22	SKC	224-PCXR8	707444	04/04/2024	1,000	1,500	2,000	1,001	1,501	2,004	1.006x – 10.948	1.000
R23	SKC	224-PCXR8	761067	04/04/2024	1,000	1,500	2,000	997	1,493	1,992	0.994x + 2.840	1.000
R24	SKC	224-PCXR8	707893	02/04/2024	1,000	1,500	2,000	997	1,507	1,998	1.006x – 14.466	0.999
R25	SKC	224-PCXR8	761052	09/04/2024	1,000	1,500	2,000	1,009	1,494	1,996	0.987x + 17.592	1.000
R26	SKC	224-PCXR8	707956	08/04/2024	1,000	1,500	2,000	1,003	1,500	2,004	1.009x – 15.934	0.999
R27	SKC	224-PCXR8	707398	09/04/2024	1,000	1,500	2,000	995	1,502	2,003	1.008x – 17.956	1.000
R28	SKC	224-PCXR8	707481	09/04/2024	1,000	1,500	2,000	1,003	1,500	2,003	1.012x – 22.471	0.999
R29	SKC	224-PCXR8	707402	08/04/2024	1,000	1,500	2,000	1,005	1,495	1,992	0.987x + 16.057	1.000
R30	SKC	224-PCXR8	093811	09/04/2024	1,000	1,500	2,000	999	1,494	1,995	0.997x + 0.921	1.000
R31	SKC	224-PCXR8	093183	04/04/2024	1,000	1,500	2,000	1,002	1,504	2,001	1.001x – 1.723	1.000
R32	SKC	224-PCXR8	671950	09/04/2024	1,000	1,500	2,000	999	1,502	1,996	0.997x + 3.418	1.000
R33	SKC	224-PCXR4	626254	04/04/2024	1,000	1,500	2,000	996	1,499	2,001	1.010x – 22.367	0.999
R34	SKC	224-PCXR4	626131	04/04/2024	1,000	1,500	2,000	1,000	1,501	2,005	1.008x – 14.071	1.000
R35	SKC	224-PCXR8	707460	08/04/2024	1,000	1,500	2,000	996	1,496	1,996	0.997x + 1.671	1.000
R36	SKC	224-PCXR8	707446	02/04/2024	1,000	1,500	2,000	1,002	1,499	2,000	1.010x – 20.385	0.999
R37	SKC	224-PCXR8	707432	04/04/2024	1,000	1,500	2,000	998	1,497	1,999	0.997x + 1.683	1.000
R38	SKC	224-PCXR8	707349	04/04/2024	1,000	1,500	2,000	999	1,499	2,000	1.000x – 3.701	1.000

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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, 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	± 3	°C
Pressure	1010	± 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
R40	SKC	224-PCXR4	612753	08/04/2024	1,000	1,500	2,000	998	1,499	1,997	1.011x – 23.404	0.999
R41	SKC	224-PCXR4	626140	05/04/2024	1,000	1,500	2,000	993	1,507	1,999	1.013x – 27.249	0.999
R42	SKC	224-PCXR4	626463	02/04/2024	1,000	1,500	2,000	1,000	1,495	1,998	0.998x + 1.113	1.000
R43	SKC	224-PCXR4	626129	09/04/2024	1,000	1,500	2,000	1,004	1,503	2,004	1.010x – 18.786	0.999
R44	SKC	224-PCXR4	602753	05/04/2024	1,000	1,500	2,000	1,003	1,494	1,992	0.993x + 5.576	1.000
R45	SKC	224-PCXR4	626137	09/04/2024	1,000	1,500	2,000	994	1,507	2,004	1.011x – 21.270	1.000
R47	SKC	224-PCXR4	A129234	08/04/2024	1,000	1,500	2,000	993	1,509	2,001	1.014x – 28.446	0.999
R48	SKC	224-PCXR4	A129253	08/04/2024	1,000	1,500	2,000	1,000	1,494	1,999	0.999x – 0.164	1.000
R49	SKC	224-PCXR4	A129168	08/04/2024	1,000	1,500	2,000	1,003	1,501	2,005	1.012x – 21.059	0.999
R50	SKC	224-PCXR4	A129282	08/04/2024	1,000	1,500	2,000	1,002	1,496	1,993	0.995x + 2.808	1.000
R51	SKC	224-PCXR4	A129284	08/04/2024	1,000	1,500	2,000	995	1,505	2,002	1.005x – 10.182	1.000

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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	02/04/2024	500	1,000	2,000	502.7	995.4	1981.1	0.999x – 2.801	0.999
H-R02	Dwyer	VFB-65	04/04/2024	500	1,000	2,000	501.2	1000.7	1990.7	1.000x – 1.869	1.000
H-R03	Dwyer	VFB-65	09/04/2024	500	1,000	2,000	502.1	993.7	1998.1	0.992x + 5.811	1.000
H-R04	Dwyer	VFB-65	08/04/2024	500	1,000	2,000	497.2	993.8	2015.1	1.006x – 10.146	1.000
H-R05	Dwyer	VFB-65	05/04/2024	500	1,000	2,000	500.1	995.3	1991.1	1.001x – 3.418	1.000

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

NSC-TISI-TIS17025
CALIBRATION 0049

CERTIFICATE No : 24M2227
REFERENCE No : 72448-1

Certificate of Calibration

EQUIPMENT	:	DIGITAL BALANCE
MANUFACTURER	:	METTLER TOLEDO
MODEL	:	XS105DU
SERIAL No	:	1126422905
ID No	:	BA05/50
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	:	ATSAWIN Y.
CALIBRATION DATE	:	08-Mar-24
APPROVED BY	:	
ISSUED DATE	:	14-Mar-24
RECEIVED DATE	:	08-Mar-24

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

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

Calibration Report

EQUIPMENT	:	DIGITAL BALANCE	**MODEL**	:	XS105DU
MANUFACTURER	:	METTLER TOLEDO	**S/N**	:	1126422905
ID No	:	BA05/50	**RECEIVED DATE**	:	08-Mar-24
AIR PRESSURE	:	1010mbar ± 1mbar	**CALIBRATION DATE**	:	08-Mar-24
AMBIENT TEMPERATURE	:	25° C ± 1° C	**RELATIVE HUMIDITY**	:	53 %RH ± 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 LINEARLITY 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	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

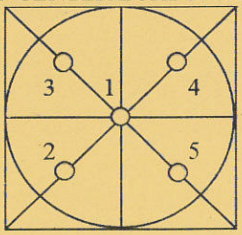
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
   - NATIONAL INSTITUTE OF METROLOGY (THAILAND) 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 200 g WAS 0.000055 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (± g)
0.00	0.00000	0.00000	0.000065
0.02	0.02001	-0.00001	0.000065
0.10	0.10002	-0.00002	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50001	-0.00001	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00001	-0.00001	0.000068
10.00	9.99994	0.00006	0.000070
20.00	20.00008	-0.00008	0.000078
50.00	50.0000	0.0000	0.00013
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	50.0000
5	50.0000
OFF-CENTER LOADING	0.0000

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

END OF CALIBRATION REPORT

SITHIPORN 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

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 :	(25.0 ± 5) °C
Relative Humidity :	(48.4 ± 25) %
Received Date :	30 AUGUST 2023
Calibration Date :	30 AUGUST 2023
Date of Issue :	31 AUGUST 2023

Calibrated by :

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. : SP23016
Job No. : VC66SP0014
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	106864	01/11/2024
Didymium liquid	RM-DL	28912	106905	02/11/2024
Neutral density filter	RM-1N2N3N	13877	106918	03/11/2024
Potassium dichromate solutions	RM-0204060810	14204	106902	02/11/2024
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	361.3	0.05	0.16	2.00
	467.82	468.0	0.18	0.16	2.00
	536.56	536.6	0.04	0.16	2.00
	640.50	640.4	-0.10	0.16	2.00
RM-DL	740.09	740.0	-0.09	0.16	2.00
	864.94	865.0	0.06	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP23016
Job No. : VC66SP0014
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	1.0517	1.0564	0.0047	0.0031	2.00
		29914	0.7	0.7445	0.7460	0.0015	0.0032	2.00
		29381	0.5	0.5416	0.5429	0.0013	0.0032	2.00
	546.1	29360	1.0	0.9821	0.9849	0.0028	0.0030	2.00
		29914	0.7	0.6961	0.6961	0.0000	0.0030	2.00
		29381	0.5	0.5073	0.5073	0.0000	0.0030	2.00
	590.0	29360	1.0	1.0222	1.0244	0.0022	0.0030	2.00
		29914	0.7	0.7237	0.7234	-0.0003	0.0030	2.00
		29381	0.5	0.5361	0.5360	-0.0001	0.0031	2.00
	635.0	29360	1.0	0.9753	0.9775	0.0022	0.0030	2.00
		29914	0.7	0.6910	0.6910	0.0000	0.0030	2.00
		29381	0.5	0.5211	0.5210	-0.0001	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	0.2422	0.2462	0.0040	0.0101	2.00
		40	0.4866	0.4900	0.0034	0.0115	2.00
		60	0.7414	0.7390	-0.0024	0.0068	2.00
		80	0.9858	0.9871	0.0013	0.0093	2.00
		100	1.2442	1.2480	0.0038	0.0087	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	
Transimission T(%)	**Absorbance(A)**
0.0111	3.9564

**Specific Acceptance :
Transmission $\leq$ 1.0 T(%), Absorbance $\geq$ 2.0 A
**Stray light not TISI Accredited

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

End of Calibration Certificate

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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 :	09 May 2024	Brand :	API	Model :	300E
No.	CO-R01			Serial No.	704

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 08 August 2023	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Carbon Monoxide (CO)			Cylinder No.	: D711839
Certified Date	: 14 March 2024	Expired Date	: 14 March 2032	Cylinder Conc.	: 4,580 ppm

Calibrating Condition

Pressure	1011	mmbar	Temp. 24.5	°C	% RH 48

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	39.92	-0.200	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	4016.3	mV	2500-4800 mV
CO Reference	3946.9	mV	2500-4800 mV
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air
Sample Pressure	28.7	In-Hg-A	~2"< Ambient Absolute Pressure
Sample Flow	810	CC/Min	800 ± 10%
Sample Temperature	48.3	°C	48 ± 4
Bench Temperature	48.0	°C	48 ± 2
Wheel Temperature	68.2	°C	68 ± 2
Box Temperature	30.9	°C	Ambient Temp + 7 ± 10
Photo-Drive	3039.6	mV	250 mV to 4750 mV
Slope	1.018	-	1.0 ± 0.3
Offset	0.2	-	0 ± 0.3

PerkinElmer

MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer :	**S.P.S.Consulting Service Co.,Ltd**	Date Tested:	January 4, 2024
		Recommendation Recertification	
Address :	**7 Soi Phaholyothin 24**	Period	6 Months
	Paholyothin Road	Recertification Due:	July 4, 2024
	Jompol Chatuchak, Bangkok 1090	Date Last Certified:	July 6, 2023
User Name:	**K.Phenpha Viphasthawat**	Visit Number:	2 of 2
Phone:	**083-9269252**	PerkinElmer Phone:	02-719-6420 ext 206
Fax:	**02-513-4221**	PerkinElmer Fax:	02-318-5597

CONFIGURATION TESTED

ACCESSORIES/COMPONENT NOT INCLUDED

MODEL	**SERIAL NUMBER**
OPTIMA 5300DV	077C7042401

TESTED EQUIPMENT	**CALIBRATION NUMBER**	**EXPIRATION**
IPV Methods		

TEST STANDARD USED	**PART NUMBER**	**EXPIRATION DATE**
Multielement Standard	N069-1579	December 30, 2024
Wavecal Solution	N058-2152	March 30, 2024
VIS Wavecal solution	N930-2946	February 28, 2024
Instrument Cal. STD4	N930-0221	November 30, 2024

CUSTOMER SUPPLIED	**COMMENTS**	**CUSTOMER INITIALS**
2 % HNO3		
10 % HNO3		

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office

PerkinElmer

MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401 **DATE TESTED** January 4, 2024

1. MECHANICAL CHECKS

A. Inspect and clean all fans and filters.	OK
B. Inspect and replace as necessary, all torch components including the RF coil.	OK
C. Inspect all tubing for sign of clacking or leaking.	OK
D. Adjust water and gas pressure regulator settings.	OK
E. Inspect and leak check pneumatics drawers.	OK
F. Clean the exterior of the instrument.	OK

2. OPTICAL CHECKS

A. Inspect and clean all optical components.	OK
B. As reqiured, check and replace all purgefilters.	OK
C. Recheck optical alignment.	OK

3. COOLING SYSTEM CHECKS

A. Perform preventive maintenance on chiller.	OK
B. Flush out the chiller every year.	N/A

4. PERFORMANCE CHECKS

A. Torch View Alignment.	OK
B. Wavelength Calibration.	OK

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office

PerkinElmer

MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401 **DATE TESTED :** January 4, 2024

PARAMETER			SPECIFICATION		FINAL VALUE	
Spectral Resolution : UV	**As**	**193.696 nm**	≤ 0.007		0.00529	
	Ni	**231.604 nm**	≤ 0.008		0.00672	
	Ni	**341.476 nm**	≤ 0.012		0.00793	
Spectral Resolution : VIS	**La**	**408.672 nm**	≤ 0.020		0.01588	
	Ba	**455.403 nm**	≤ 0.025		0.02280	
Precision						
	As	**193.656 nm**	% RSD	< 1.0	0.92	%
	Zn	**213.856 nm**	% RSD	< 1.0	0.95	%
	Mn	**257.610 nm**	% RSD	< 1.0	0.75	%
	La	**379.478 nm**	% RSD	< 1.0	0.44	%
	Ba	**455.403 nm**	% RSD	< 1.0	0.46	%
	Ba	**493.408 nm**	% RSD	< 1.0	0.37	%
Detection Limits : Axial	**Tl**	**190.080 nm**	3(sd)		19.99	ppb
	As	**193.696 nm**	3(sd)		26.66	ppb
	Pb	**220.353 nm**	3(sd)		1.81	ppb
Detection Limits : Radial	**As**	**193.696 nm**	3(sd)		38.21	ppb
	Zn	**213.856 nm**	3(sd)		2.48	ppb
	Mn	**257.610 nm**	3(sd)		0.59	ppb
	La	**379.478 nm**	3(sd)		5.52	ppb
	Ba	**455.403 nm**	3(sd)		0.13	ppb
	Ba	**493.408 nm**	3(sd)		1.08	ppb
BEC : Axial (IB X 500)/(IS-IB)	**Cd**	**226.502 nm**	≤ 150 ppb		141.47	
BEC : Radial (IB X 1000)/(IS-IB)	**Mn**	**257.610 nm**	≤ 45 ppb		29.04	

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office

PerkinElmer

MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401 **DATE TESTED** January 4, 2024

Remarks :

Commissioning follow as commissioning performance sheets.

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

- [x] meets
- [ ] does not meet

PerkinElmer
For the Better

PinAAcle 900T
Preventive Maintenance Report

Company Name: S.P.S. Consulting Service Co.,Ltd.

Instrument Location: AAS Room

Instrument Serial No.: PTCS14111103

Date: 04-Jan-2024

PinAAcle 900T Preventive Maintenance (PM)

Company Name:	S.P.S. Consulting Service Co.,Ltd.		
Address (Instrument Location):	7, Soi Phaholyothin 24, Phaholyothin Road , Ladyao, Khet Jatujak,Bangkok,		
Serial Number:	PTCS14111103	**PM Number:**	1OF2
Customer Name (if applicable):	K PHENPA	**Telephone Number:**	
Customer Support Engineer Name:	WIPHAN	**Service Order Number:**	WO-02602325
Date PM Performed: (DD-MMM-YYYY)	04-Jan-2024	**Next PM Due Date:** (DD-MMM-YYYY)	04-Jul-2024
Standard Labor Hours to Complete PM :		**5 hours**	

Part Number	Release	Publication Date	
09370143 Rev.8	A	January 2018	PerkinElmer®

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T 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

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	**Description**	**Quantity**
B0501696	Fan Filters	1
B3002013	THGA Contact Cylinders	1
B3141064	Glycerol for THGA Cooling	N/A
N3160156	O-Ring Kits for Sampling Introduction (Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction (Plastic Nebulizer)	1
N9301714	Replacement Acetylene Filter Cartridge	1
TH001022	Replacement Air Filter Cartridge	1

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	**Description**	**Quality**	**Batch/Lot #**	**Expired Date (MM/YY)**
N9300183	1000 mg/L Copper Standard	AR	26-87CYUY1	30-Jan-2024
N9300244	GFAAS Mixed Standard	AR	58-142CRY1	30-Oct-2024

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% $HN0_3$	250 ml.	AR	AR

Additional Tools Required for PM			
Part Number (if applicable)	**Description**	**Quantity**	**Serial #**
N1013000	0.2A Neutral density filter	1	MG0-252
N1013002	1.0A Neutral density filter	1	MG2-358
B3100652 Or N9307029	Electronic Flow Meter	1	N/A
B0505495	Test Jig	1	N/A
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	1-2416--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.

   3.1 Flame Technique
   ☑ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
   ☑ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
   ☑ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
   ☑ Check the drain system for signs of wear. Replace worn or damaged parts.
   ☑ Visually check for proper flame conditions when igniting the Air-C2H2 and N20-C2H2 flames (if applicable).

   3.2 THGA Technique
   ☑ 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.

4. Electrical:

☑ Inspect PC boards. Clean if necessary.
☑ Carefully check all internal and external cable connections.
☑ 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. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C_2H_2 Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C_2H_2 Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C_2H_2 Flame correctly shuts down	Active	Passed
C_2H_2 Pressure Sensor	Air/C_2H_2 Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C_2H_2 Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

8. After PM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.		0.1789	Passed
0.2 A ND Filter	± 5% from Cert.		1.0186	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0017	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D_2 Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0084	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0004	Passed

8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0013	Passed

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	N/A	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.4241	Passed

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min ± 25 mL/min	251	Passed
External Flow Rate	100 mL/min ± 10 mL/min	102	Passed

9.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0008	Passed
Standard Deviation	≤ 0.005	0.0003	Passed

9.3 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	≤ 7.0 pg/0.0044 A-s	6.2	Passed
Precision	≤ 2.0 %	0.61	Passed

9.4 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	13.6	Passed
Zeeman Ratio	0.52 ± 0.04	0.544	Passed

10. 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 $= \frac{Atomic\ Signal\ (Peak\ area\ )}{Atomic\ Signal\ (Peak\ area\ ) + Background\ Signal\ (Peak\ area\ )}$ $= \frac{0.1602}{0.2940}$ $= 0.544$

Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed. ***This PinAAcle 900T Passes ☑ Fails ☐ the preventive maintenance.***	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative	Date: 04-Jan-2024 (DD-MMM-YYYY)
Authorized Customer Representative:	Date: 04-Jan-2024 (DD-MMM-YYYY)

คุณภาพน้ำ

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

NSC-TISI-TIS17025
CALIBRATION 0049

CERTIFICATE No : 23E8494
REFERENCE No : 70413-1

Certificate of Calibration

EQUIPMENT	:	pH METER
MANUFACTURER	:	HANNA
MODEL	:	HI 3512
SERIAL No	:	TH118035
ID No	:	pH04/56
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	:	ATSAWIN Y.
CALIBRATION DATE	:	06-Sep-23
APPROVED BY	:	
ISSUED DATE	:	06-Sep-23
RECEIVED DATE	:	31-Aug-23

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

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

CERTIFICATE No : 23E8494

Calibration Report

EQUIPMENT	:	pH METER			
MANUFACTURER	:	HANNA	**MODEL**	:	HI 3512
ID No	:	pH04/56	**SERIAL NUMBER**	:	TH118035
RECEIVED DATE	:	31-Aug-23	**CALIBRATION DATE**	:	06-Sep-23
AMBIENT TEMPERATURE	:	23 ° C ± 3 ° C	**RELATIVE HUMIDITY**	:	50 % RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-062 AND WI-TQ-063. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTROD WAS CALIBRATED BY USING STANDARD pH BUFFER
2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	CC767907	4880-13836406	29-Dec-24
2) pH STANDARD SOLUTION	00651-08	CC765602	4881-13757019	18-Nov-24
3) pH STANDARD SOLUTION	00651-10	CC767180	4882-13813369	14-Dec-24
4) PROCESS CALIBRATOR	CA150	91S6079	23E1312	19-Apr-24
5) BATH	260014	1247 48074	22T9870	13-Sep-23
6) THERMOMETER WITH PROBE	421504	55000379	22T9904	13-Sep-23

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO SI UNIT MAINTAINED AT :-
   - NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
   - NATIONAL INSTUTITE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION : ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR k = 2.303 RT/F = 59 mV/pH

mV APPLIED	UUC READING (mV)	CORRECTION (mV)	UUC READING (pH)	UNCERTAINTY OF MEASUREMENT (± mV)	COVERAGE FACTOR k
414.11	414.6	-0.49	-0.290	0.15	2.00
354.95	355.4	-0.45	0.741	0.15	2.00
295.80	296.3	-0.50	1.773	0.15	2.00
236.64	237.1	-0.46	2.804	0.15	2.00
177.48	177.9	-0.42	3.835	0.15	2.00
118.32	118.7	-0.38	4.867	0.15	2.00
59.16	59.6	-0.44	5.898	0.15	2.00
0.00	0.4	-0.40	6.930	0.15	2.00
-59.16	-58.8	-0.36	7.961	0.15	2.00
-118.32	-117.9	-0.42	8.992	0.15	2.00
-177.48	-177.1	-0.38	10.024	0.15	2.00
-236.64	-236.3	-0.34	11.055	0.15	2.00
-295.80	-295.5	-0.30	12.087	0.15	2.00
-354.95	-354.6	-0.35	13.118	0.15	2.00
-414.11	-413.8	-0.31	14.149	0.15	2.00

END OF CALIBRATION REPORT PAGE 2 OF 3

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CERTIFICATE No : 23E8494

Calibration Report

RESULT OF CALIBRATION (CONTINUE) :

2. DISPLAY UNIT WITH pH ELECTRODE S/N: 09081C6M

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (± pH)	COVERAGE FACTOR k
4.006	4.006	0.000	4.015	0.012	2.00
7.000	7.000	0.000	6.914	0.012	2.00
10.008	10.010	-0.002	9.996	0.014	2.00

3. DISPLAY UNIT WITH TEMPERATURE

STANDARD READING (°C)	UUC READING (°C)	CORRECTION (°C)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (± °C)	COVERAGE FACTOR k
25.005	25.0	0.005	---	0.0085	2.00

4. PERCENT SLOPE 100%

UUC : UNIT UNDER CALIBRATION

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

Scientific

CAL
Calibratech Co.,Ltd.
7/106-7 Moo 2, Sukhaprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120
Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech_cal@yahoo.com, calibratech_cal@hotmail.com

NSC-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-400037-2 **Page : 1 of 2**

Submitted by : S. P. S Consulting Service Co.,Ltd.
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Equipment : Liquid in Glass Thermometer

Manufacturer : SK Model : N/A
Range : 0 °C to 100 °C Resolution : 1 °C
Serial No. : N/A Immersion : Total
ID No. : TM21/59

Environment :
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Line Voltage : (220 ± 22) VAC

Date of Received : 23 January 2024
Date of Calibration : 03 February 2024
Date of Issue : 03 February 2024
Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4001 based on ASTM E77-07 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400001	TT-0016-22	07 Feb 2024	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)
400004	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)

The Uncertainties are for a confidence probability of approximately 95%

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CAL
Calibratech Co.,Ltd.
7/106-7 Moo 2, Sukhaprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120
Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech_cal@yahoo.com, calibratech_cal@hotmail.com

Certificate of Calibration

Certificate No. : 67-400037-2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Ice point check : UUC* reading 0 °C Standard reading 0.4336 °C

Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (±°C)
20.5609	20	0.6	0.31

CAL

Remark

UUC : Unit Under Calibration

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

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

- o0o -

Harikul Science Co.,Ltd.
694 Soi Ratchadanivet 24, Pracharatbamphen,
Samsaennok, Huaikhwang, Bangkok 10310
Tel: 0-2274-2456 Fax: 0-2274-2443
Email: info@harikul.com www.harikul.com

CERT.No.: HS-V015C

Certificate of Calibration

Calibration Date : 20 Mar 24

Submitted by : ASIA LAB @ CONSULTANT CO.,LTD
184 Soi Phutthamonthon Sai 2 Soi 12,
Bangphai, Bangkae, Bangkok 10160

Avg Room Temp : 20 °C
Avg Water Temp : 20 °C
Air Pressure : 760.00 mmHg
Salinity : 0 ppt

Model : YSI 5000
S/N : 15B100751
Probe : YSI 5010
S/N : 22D100097
ID NO. : -
Air Temp ref : S/N. F8065C26
Barometric ref : S/N. F8065C26
Water Temp ref : S/N. 11430

Technician : Kittipong M.

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)		(status)
Measurement 1 (mg/l)	9.08	(PASS)	-	-
Measurement 2 (mg/l)	9.08	(PASS)	-	-
Measurement 3 (mg/l)	9.08	(PASS)	-	-
Measurement 4 (mg/l)	9.08	(PASS)	-	-
Measurement 5 (mg/l)	9.08	(PASS)	-	-
Measurement 6 (mg/l)	9.08	(PASS)	-	-
Measurement 7 (mg/l)	9.08	(PASS)	-	-
Measurement 8 (mg/l)	9.08	(PASS)	-	-
Measurement 9 (mg/l)	9.08	(PASS)		-
Measurement 10 (mg/l)	9.08	(PASS)	-	-
Mean Measurement	9.08	mg/l	-	-
Inaccuracy	0.01	mg/l	-	-

Overall Status (PASS)

Manufacturer Specification

Accuracy = +/- 0.02 mg/l

1) This certificate is issued based on the result that are found as shown on date and place of test only.
2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
3) This result shall not be used for advertising purpose.

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235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com

NSC-TISI-TIS17025
CALIBRATION 0049

CERTIFICATE No : 24M2229
REFERENCE No : 72448-3

Certificate of Calibration

EQUIPMENT	:	DIGITAL BALANCE
MANUFACTURER	:	SARTORIUS
MODEL	:	BSA224S-CW
SERIAL No	:	36591843
ID No	:	BA 09/61
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	:	ATSAWIN Y.
CALIBRATION DATE	:	08-Mar-24
APPROVED BY	:	
ISSUED DATE	:	14-Mar-24
RECEIVED DATE	:	08-Mar-24

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235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com

Calibration Report

EQUIPMENT	:	DIGITAL BALANCE	**MODEL**	:	BSA224S-CW
MANUFACTURER	:	SARTORIUS	**S/N**	:	36591843
ID No	:	BA 09/61	**RECEIVED DATE**	:	08-Mar-24
AIR PRESSURE	:	1010mbar ± 1mbar	**CALIBRATION DATE**	:	08-Mar-24
AMBIENT TEMPERATURE	:	25° C ± 1° C	**RELATIVE HUMIDITY**	:	55 %RH ± 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 LINEARLITY 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	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

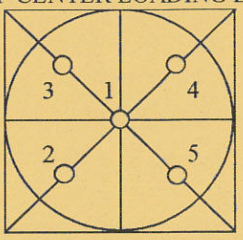
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
   - NATIONAL INSTITUTE OF METROLOGY (THAILAND) 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 200 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (± g)
0.0	0.0000	0.0000	0.000082
0.1	0.1000	0.0000	0.000083
0.2	0.2000	0.0000	0.000083
0.5	0.5000	0.0000	0.000083
1.0	1.0000	0.0000	0.000084
2.0	2.0000	0.0000	0.000084
5.0	5.0000	0.0000	0.000086
10.0	10.0000	0.0000	0.000089
20.0	20.0001	-0.0001	0.000094
50.0	50.0000	0.0000	0.00012
100.0	100.0001	-0.0001	0.00019
200.0	200.0000	0.0000	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	100.0000
3	100.0000
4	100.0000
5	100.0000
OFF-CENTER LOADING	0.0000

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY 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

ระดับเสียงทั่วไป

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304 **MTC No.** EEL. BP. 109/0267

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 + 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) 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/N4106495.
7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

Date of Receipt : 22 Feb. 2024

Date of Calibration : 4 Mar. 2024

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.

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304 **MTC No.** EEL. BP. 109/0267

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	93.85	-0.15	± 0.10	±0.75 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	999.9	-0.1	± 1.5	±2.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1.65	± 0.50	±4.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

The results relate only to the items tested/calibrated or value assigned.
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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
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Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
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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

Noise R_289/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	04 March 2024
		Due Date	04 March 2025

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R32	ACO	6236	00192044	12 May 2024	93.9	93.9
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.85 ± 0.10 dB	

ระดับเสียงในสถานประกอบการ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304 **MTC No.** EEL. BP. 110/0267

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 : Acoustic Calibrator

Manufacturer : Cirrus

Model : CR:515

Serial No. : 92002

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) 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 Feb. 2024

Date of Calibration : 5 Mar. 2024

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.

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
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Office
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Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304 **MTC No.** EEL. BP. 110/0267

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	94.04	0.04	± 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	1000.3	0.3	± 1.5	±1.0%

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.70	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

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

Noise R_203/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	CIRRUS	Number	AC-CR01/63
Model	CR515	Serial No.	92002
Calibration Range	94 dB, 1000 Hz	Last Calibration	05 March 2024
		Due Date	05 March 2025

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
CR-B03	Cirrus	CR161B	G301155	09 April 2024	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					94.04 ± 0.10 dB	

ปริมาณเสียงสะสม

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304 **MTC No.** EEL. BP. 109/0267

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 + 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) 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/N4106495.
7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

Date of Receipt : 22 Feb. 2024

Date of Calibration : 4 Mar. 2024

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.

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304 **MTC No.** EEL. BP. 109/0267

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	93.85	-0.15	± 0.10	±0.75 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	999.9	-0.1	± 1.5	±2.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1.65	± 0.50	±4.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

The results relate only to the items tested/calibrated or value assigned.
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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise R_197/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	04 March 2024
		Due Date	04 March 2025

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R52	ACO	6236	00192064	08 April 2024	93.9	93.9
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.85 ± 0.10 dB	