

## ภาคผนวกที่ 4

เอกสารการสอบเทียบความถูกต้องของเครื่องมือ



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

### SO<sub>2</sub> FLUORESCENT ANALYZER

DATE : 11 December 2022

BRAND : API

MODEL : 100E

NO. SO<sub>2</sub>-R02

SERIAL NO. 3431

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO<sub>2</sub>)

Cylinder No. : A00814SK

Certified Date : 21 June 2021

Expired Date : 21 June 2029

Cylinder Conc. : 50.0 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

Span 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 <sub>2</sub> Span	400.0	400.2	0.050	400.0	1.015

#### API Model 100E SO<sub>2</sub> 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	658	cc/min	650 ± 10%
PMT	103.3	mV	-20-150 with Zero Air
UV LAMP	3024.5	mV	1000-4900
STR. LGT	61.4	PPB	<100
DRK PMT	63.1	mV	-50 - 200
DRK LMP	58.0	mV	-50 - 200
HVPS	672	V	550-900 constant
DCPS	2524	mV	2500 ± 200
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.2	°C	5-40
PMT TEMP	7.3	°C	7 ± 2.0
SO <sub>2</sub> Span Conc	400	PPB	20-20,000
SO <sub>2</sub> Slope	1.015	-	1.0 ± 0.3
SO <sub>2</sub> 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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## CALIBRATION REPORT

### SO<sub>2</sub> FLUORESCENT ANALYZER

DATE : 11 December 2022

BRAND : API

MODEL : 100E

NO. SO<sub>2</sub>-R09

SERIAL NO. 76

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO<sub>2</sub>)

Cylinder No. : A00814SK

Certified Date : 21 June 2021

Expired Date : 21 June 2029

Cylinder Conc. : 50.0 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

Span 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 <sub>2</sub> Span	400.0	399.8	-0.050	400.0	1.006

#### API Model 100E SO<sub>2</sub> 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	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	63.2	mV	-50 - 200
DRK LMP	57.8	mV	-50 - 200
HVPS	674	V	550-900 constant
DCPS	2515	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 <sub>2</sub> Span Conc	400	PPB	20-20,000
SO <sub>2</sub> Slope	1.006	-	1.0 ± 0.3
SO <sub>2</sub> 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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## CALIBRATION REPORT

### CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE : 11 December 2022

BRAND : API

MODEL : 200E

NO. NOX-R04

SERIAL NO. 4411

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

Span Set Point	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.10	-	0	-
NO Span	400	400.1	0.025	400.0	1.006
NO <sub>x</sub> Span	400	400.2	0.050	400.0	1.010

#### API Model 200E NO<sub>x</sub> 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	102.9	mV	-20 - 150
AZERO	93.7	mV	-20 - 150
HVPS	669	V	420 - 900 constant
RCELL TEMP	50.5	°C	50 ± 1
BOX TEMP	29.2	°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	28.5	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.006	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.010	-	1.0 ± 0.3
NO Offset	1.4	mV	-20 to +150
NO <sub>x</sub> Offset	0.9	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<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE : 11 December 2022

BRAND : API

MODEL : 200E

NO. NOX-R07

SERIAL NO. 4468

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

Span Set Point	Initial Reading (Before Adj.), PPB			Final Reading (After Adj.), PPB	
	Expected Concentration	Analyzer Response	% Dif	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
NO Span	400	399.7	-0.075	400.0	1.003
NO <sub>x</sub> Span	400	400.1	0.025	400.0	1.007

#### API Model 200E NO<sub>x</sub> 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	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	50.0	°C	50 ± 1
BOX TEMP	29.4	°C	8 - 48
PMT TEMP	7.2	°C	7 ± 2
MOLY TEMP	314.7	°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 <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.003	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.007	-	1.0 ± 0.3
NO Offset	1.2	mV	-20 to +150
NO <sub>x</sub> 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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## Console Calibration Report

Calibration Method

Critical Orifices

### Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	y	$\Delta H_{@}$ (mmH <sub>2</sub> O)
B01	1563	01/12/2022	1.007	49.94
B02	8002514	02/12/2022	1.002	49.41
B03	1503016	05/12/2022	1.004	50.46
B04	00006659	01/12/2022	1.007	49.43
B05	00007428	01/12/2022	0.998	49.80
R01	1561	01/12/2022	1.004	49.52
R02	8002513	01/12/2022	1.003	49.77
R03	1570	05/12/2022	1.008	49.68
R04	8002519	05/12/2022	0.997	50.12
R05	1503015	01/12/2022	1.003	50.08

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

Accept Value of  $\Delta H_{@}$  (test) is  $46.7 \pm 6.4$  (mmH<sub>2</sub>O)



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## Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

### Calibration Data

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

Remark : Accept value of Cp (test) is  $0.84 \pm 0.01$

## CERTIFICATE OF CALIBRATION

### FOR

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

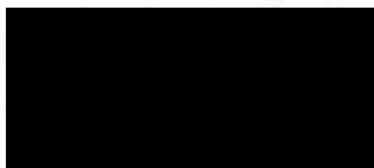
CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,  
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 20 July 2022

DATE OF ISSUED : 22 July 2022

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

Calibrated By : Sittipong Pimdee  
Calibration Engineer



Approved By : Mongkol Yotsoontorn  
Authorized Signatory  
22 July 2022



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

Certificate No. Q22073201

F3-011-04/01-12

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@clccalibration



## REPORT OF CALIBRATION

### FOR

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

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#### ENVIRONMENT CONDITIONS :

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

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

#### PROCEDURE USED :

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

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

#### REFERENCE STANDARD USED :

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

#### TRACEABILITY :

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

#### UNCERTAINTY :

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

Certificate No. **Q22073201**

F3-011-04/01-12

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

Uncertainty of measurement  $\pm 0.2$  inHg

Transmitting fluid : Air.

Technical Note. k factor 1 kPa = 0.2952998 inHg

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

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

### End of Certificate ###

Certificate No. Q22073201

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

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





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

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

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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

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

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
R40	SKC	224-PCXR4	612753	05/10/2022	1,000	1,500	2,000	1,001	1,501	2,003	1.012x - 23.763	0.999
R41	SKC	224-PCXR4	626140	05/10/2022	1,000	1,500	2,000	991	1,509	2,001	1.017x - 33.838	0.999
R42	SKC	224-PCXR4	626463	05/10/2022	1,000	1,500	2,000	995	1,493	1,999	1.003x - 6.593	1.000
R43	SKC	224-PCXR4	626129	05/10/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.005x - 16.073	0.999
R44	SKC	224-PCXR4	602753	05/10/2022	1,000	1,500	2,000	1,002	1,496	1,993	0.996x + 1.571	1.000
R45	SKC	224-PCXR4	626137	05/10/2022	1,000	1,500	2,000	992	1,505	2,002	1.019x - 37.487	0.999



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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 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 <sup>2</sup>
H-R01	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	502.9	992.8	1978.7	0.999x + 3.447	0.999
H-R02	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	500.8	995.3	1985.7	1.002x - 5.358	1.000
H-R03	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	502.1	987.7	1996.9	0.994x + 1.850	1.000
H-R04	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	496.0	989.6	2019.5	1.007x - 11.659	1.000
H-R05	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	497.2	988.1	1988.1	1.004x - 9.026	1.000
H-R06	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	505.6	992.4	1979.8	0.999x - 2.422	0.999



**QUALITY CALIBRATION CO.,LTD.**

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

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

[www.qcalibration.com](http://www.qcalibration.com)

CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : DIGITAL BALANCE

**MANUFACTURER** : METTLER TOLEDO

**MODEL** : XS 105DU

**SERIAL No** : 1126422905

**ID No** : BA 05/50

**CONDITION AS RECEIVED** : USED ITEM

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

**CALIBRATED BY** : TETNITHI W.

**CALIBRATION DATE** : 11-Mar-22

**APPROVED BY** : 

**ISSUED DATE** : 17-Mar-22

**RECEIVED DATE** : 11-Mar-22

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





CERTIFICATE No : 22M2567

PAGE : 2 OF 2

## Calibration Report

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

### CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

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

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

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

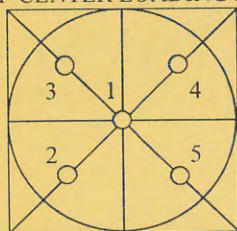
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.00	0.00000	0.00000	0.000058
0.02	0.01999	0.00001	0.000058
0.10	0.09999	0.00001	0.000059
0.20	0.19999	0.00001	0.000059
0.50	0.50001	-0.00001	0.000058
1.00	1.00001	-0.00001	0.000059
2.00	2.00000	0.00000	0.000059
5.00	5.00001	-0.00001	0.000061
10.00	10.00005	-0.00005	0.000063
20.00	20.00006	-0.00006	0.000069
50.00	50.00000	0.00000	0.00011
100.00	100.00001	-0.00001	0.00019
120.00	120.00001	-0.00001	0.00022

6. OFF CENTER LOADING ERROR



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

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

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : SP22018

Pages 1 of 3

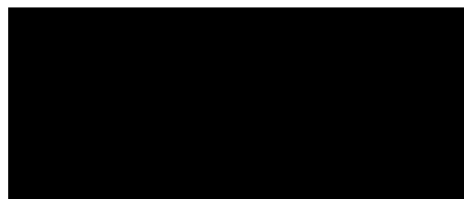
## Calibration Certificate

**Equipment :** UV-VIS SPECTROPHOTOMETER  
**Manufacturer :** PERKINELMER  
**Model :** LAMBDA 25  
**Serial No.:** 501S14123010  
**ID No.:** SP03/58  
**Calibration Mode :** WAVELENGTH ACCURACY  
PHOTOMETRIC ACCURACY  
  
**Condition As Found :** GOOD  
  
**Customer :** S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,  
CHOMPHON, CHATUCHAK,  
BANGKOK 10900, THAILAND.  
  
**Location :** ORGANIC LABORATORY IV  
  
**Ambient Temperature :** ( 24.4 ± 5 ) °C  
**Relative Humidity :** ( 60.1 ± 25 ) %  
  
**Received Date :** 30 AUGUST 2022  
**Calibration Date :** 30 AUGUST 2022  
**Date of Issue :** 31 AUGUST 2022

**Calibrated by :**

Nathakorn Pisutpaisan

**Approved by :**



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

## Continuation of Calibration Certificate

Cert. No. : SP22018

Job No. : VC65SP0008

Pages : 2 of 3

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Certified reference materials

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

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology,NIST.

**Result of calibration : Wavelength Accuracy**

(Without adjustment)

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

UUC\* = Unit Under Calibration



Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
Pages : 3 of 3

**Result of calibration : Photometric Accuracy**

(Without adjustment)

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

UUC\* = Unit Under Calibration

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

Resolution of Wavelength Mode 0.1 nm  
Resolution of Photometric Mode 0.0001 A  
Parameter Setting  
Measurement Mode Wavelength, Absorbance  
Wavelength Scan 1100 nm-190 nm  
Scanning Speed 7.5 nm/min  
Data Pitch 0.1 nm  
Band width(Wavelength) 1.0 nm  
Band width(Vis) 1.0 nm  
Band width(Uv) 1.0 nm

Stray Light** UUC* Reading at 220 nm	
Transmission T(%)	Absorbance(A)
0.0107	3.9886

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

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

**End of Calibration Certificate**



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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

### Calibration Report

#### Non-Dispersive Infrared CO Analyzer

Date : 06 December 2022

Brand : API

Model : 300E

No. CO-R01

Serial No. 704

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 06 September 2022

Serial No. : 421

#### Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D196045

Certified Date : 16 April 2022

Expired Date : 15 April 2024

Cylinder Conc. : 4,570 ppm

#### Calibrating Condition

Pressure 1011

mmbar

Temp. 24.6 °C

% RH 49

#### Calibration Setting

Span Set Point	Initial Reading (Before Adj.), PPM			Final Reading (After Adj.), PPM
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response
Zero	0	-0.10	-	0
CO Span	40.00	39.96	-0.100	40.00

#### API Model 300E CO Analyzer Check List

Parameter	Observed Value	Units	Nominal Range
Range	50	PPM	0-1000 ppm
Stability	0.10	PPM	< 1 ppm With Zero Air
CO Measure	4014.4	mV	2500-4800 mV
CO Reference	3948.6	mV	2500-4800 mV
Measure/Reference Ratio	1.179	-	1.1-1.3 W/Zero Air
Sample Pressure	28.6	In-Hg-A	~2" < Ambient Absolute Pressure
Sample Flow	814	CC/Min	800 ± 10%
Sample Temperature	48.2	°C	48 ± 4
Bench Temperature	48.1	°C	48 ± 2
Wheel Temperature	68.5	°C	68 ± 2
Box Temperature	30.7	°C	Ambient Temp + 7 ± 10
Photo-Drive	3029.5	mV	250 mV to 4750 mV
Slope	1.017	-	1.0 ± 0.3
Offset	0.2	-	0 ± 0.3

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

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	August 30, 2022
Wavecal Solution	N058-2152	November 30, 2022
VIS Wavecal solution	N930-2946	August 30, 2023
Instrument Cal. STD4	N930-0221	August 30, 2022
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
2 % HNO3		
10 % HNO3		





## MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

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

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

**2. OPTICAL CHECKS**

- |   |                             |
|---|-----------------------------|
| A. Inspect and clean all optical components.        | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment.                       | <input type="checkbox"/> OK |

**3. COOLING SYSTEM CHECKS**

- |   |                              |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK  |
| B. Flush out the chiller every year.          | <input type="checkbox"/> N/A |

**4. PERFORMANCE CHECKS**

- |                            |                             |
|----------------------------|-----------------------------|
| A. Torch View Alignment.   | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : July 11, 2022

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





## MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED July 11, 2022**Remarks :**

Commissioning follow as commissioning performance sheets.

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

☒

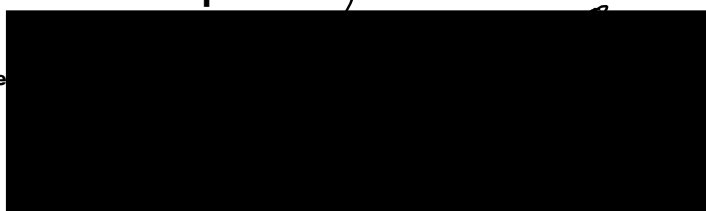
meets

☐

does not meet


the PerkinElmer Specifications listed on this certificate.

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

**Service Department PerkinElmer Ltd.****Authorized Representative**

## ***PinAAcle 900Z Preventive Maintenance (PM)***

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

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

### **Scope**

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

The customer should save their method before the PM begins.

### **General Instructions:**

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

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

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

Update the PM sticker and instrument logbook as required.

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PerkinElmer shall not be liable for incidental or consequential damages in connection with the furnishing or use of this document.

## Component List

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

## Parts Lists

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

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

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



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

# Procedure Checklist

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

## 1. General:

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

## 2. PC Instrument Software:

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

## 3. Mechanical:

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

#### 4. Electrical:

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

#### 5. Optics:

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

#### 6. Gasses:

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

#### 7. After PM Performance tests [THGA]:

##### 7.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

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

##### 7.2 Chromium Baseline Noise

Description: Signal to noise check.

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

##### 7.3 Chromium Characteristic Mass and Precision

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

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



#### 7.4 Copper Characteristic Mass and Zeeman Ratio

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

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



#### 8. Review:

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

## Additional Comments

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

## Review

<b><i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900Z have been completed.</i></b>		
<b><i>This PinAAcle 900Z Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i></b>		
<b>Review of Preventive Maintenance:</b>		
Authorized PerkinElmer Representative:		Date: 01-Jun-2022 <small>(DD-MMM-YYYY)</small>
Authorized Customer Representative:		Date: 01-Jun-2022 <small>(DD-MMM-YYYY)</small>





## Certificate of Analysis – Certified Reference Material

## Certipur® Buffer solution pH 10.00 (20°C)

Certified Reference Material for pH measurement

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



Certified value

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

pH value 10.01

 $\pm 0.03$  (20°C)

## Metrological traceability:

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

NIST 189c, 188, 185i, 186 Ig, 186 IIg, 187f

PTB OX-405/18, TA-442/19, PHT-340/16, PHO-346/16, BO-373/17

PTB: Physikalisch Technische Bundesanstalt, Braunschweig, Germany

NIST: National Institute of Standards and Technology, Gaithersburg, USA.

## Measurement method:

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

## Accreditation:

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

## Certificate issue date:

2020/06/24



ISO 17034



ISO/IEC 17025

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

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



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

**Associated uncertainty:**

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

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

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

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

**Informative values:**

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

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

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

**Certificate of analysis revision history:**

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







# Certificate of Calibration

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

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

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

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

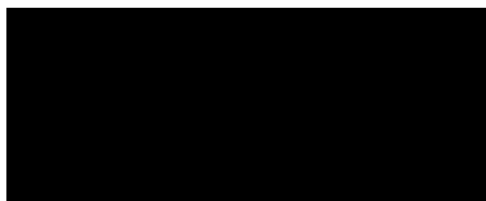
**Calibration Place:** IRPC PUBLIC CO., LTD.(Gc Lab 207)  
299 Moo 5, Sukhumvit Road, Tambol Choengneon,  
Amphur Muang, Rayong 21000 Thailand

**Calibration By:** Mr. Dumrong Boonsopon

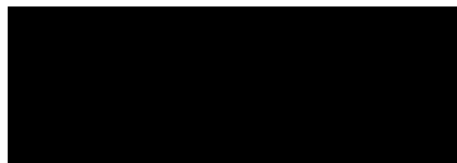
**Calibration Date:** 27 April 2022

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

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



Person in charge



Authorized signatory

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

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

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



**Calibration Results:****pH Scale**

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

**Electrode Test Results\***

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

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

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

**Sample Test Results**

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

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

**The End of Certificate**

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2205346

ชนิดเครื่องมือ: pH METER

รุ่น: HQ40d

หมายเลขเครื่อง: 130500088588

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

เพิ่มเติม/ข้อแนะนำ : Electrode วัดอุณหภูมิได้  $25.1^{\circ}\text{C}$  โดย Control Waterbath ที่  $25.0 \pm 0.5^{\circ}\text{C}$ Mr. Dumrong Boonsopon  
Service Engineer

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

**Request No.** 21-64/0528

**MTC No.** EEL. BP. 17/0564

## CALIBRATION CERTIFICATE

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

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

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

**Instrument Calibrated :**

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

**Ambient Environment**

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

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

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

**Standards used :**

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N 4106495.
7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

**Calibration Procedure:** CP-102-04 based on IEC 60942-2003; The sound pressure level 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** : 6 May 2021

**Date of Calibration** : 15 May 2021

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0528

MTC No. EEL. BP. 17/0564

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.96	-0.04	$\pm 0.10$	$\pm 0.40$ dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	999.9	-0.1	$\pm 1.5$	$\pm 1.0\%$

3. Total Distortion

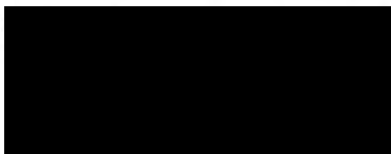
Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.26	$\pm 0.50$	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Acting Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 15 May 2021

Date of Issue : 18 May 2021

Ref : 2011264050601894002

End of Certificate

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

## CALIBRATION CERTIFICATE

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

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

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

### Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

### Ambient Environment

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

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

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

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

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

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

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

**Calibration Procedure:** CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.93	-0.07	$\pm 0.10$	$\pm 0.40$ dB

2. Frequency

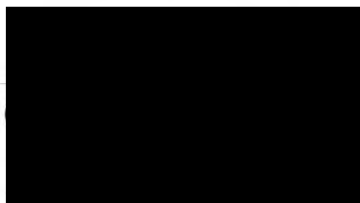
Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	999.9	-0.1	$\pm 1.5$	$\pm 1.0\%$

3. Total Distortion

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

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

Calibrated by :



(Mr. Tawikiat Iamsamran)

Approved by :



Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Ref : 2011265042601787001

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End of Certificate

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