

เอกสารแนบ 5-4

เอกสารสอบเทียบเครื่องมือการตรวจวิเคราะห์คุณภาพน้ำทิ้ง



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CH1216

Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	HANNA
Model :	HI 3512
Serial No. :	08685754
ID No. :	-
Condition As-Received:	Used Item
Received Date :	14 September 2021
Calibration Date :	16 September 2021
Reference :	2109-0508WN-1
Submitted by :	S.P.S. Consulting Service Co.,Ltd. 7 Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok10900
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

Calibrated by :

Approved by :

Issue Date :

22 September 2021

The Uncertainties are for a confidence probability of approximately 95%

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

A 0032410



Cert. No.: 21CH1216

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	46530031	130RC098	20E3666	14 Oct 2021

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	754028	28 June 2023
pH 6.985	CPA chem	725927	12 Jan 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

Calibration Results**Function : mV Measurement**

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: 08685754	4.000	177.48	177.9	4.000	0.058	2.00
	7.000	0.00	0.4	7.000	0.058	2.00
	10.000	-177.48	-177.2	10.000	0.058	2.00

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor <i>k</i>
pH Electrode S/N.: 061416CM	4.008	4.008	169.2	0.0046	2.00
	6.985	6.985	-4.4	0.0075	2.00
	10.015	10.013	-178.9	0.013	2.05

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

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a 1072797

**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



CERTIFICATE No : 22E9693

REFERENCE No : 66476-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER

MANUFACTURER : HANNA

MODEL : HI 3512

SERIAL No : TH118035

ID No : pH 04/56

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

:

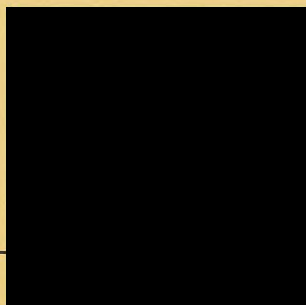
**CALIBRATION DATE**

:

15-Sep-22

APPROVED BY

:

**ISSUED DATE**

:

15-Sep-22

RECEIVED DATE

:

14-Sep-22

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
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CERTIFICATE No : 22E9693

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER
MANUFACTURER : HANNA
ID No : pH 04/56
RECEIVED DATE : 14-Sep-22
AMBIENT TEMPERATURE : 20 ° C ± 1 ° C
MODEL : HI 3512
SERIAL NUMBER : TH118035
CALIBRATION DATE : 15-Sep-22
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 ELECTRODE WAS CALIBRATED BY USING STANDARD pH BUFFER
2. REFERENCE STANDARD INSTRUMENTS :-

<u>INSTRUMENT</u>	<u>MODEL</u>	<u>SERIAL No/</u> <u>LOT No</u>	<u>CERTIFICATE No</u>	<u>DUE DATE</u>
1) pH STANDARD SOLUTION	00651-06	CC719181	4880-12119147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	CC718727	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	CC717045	4882-12065386	17-Mar-23
4) PROCESS CALIBRATOR	CA150	91S6079	22E1145	31-Mar-23
5) BATH	260014	1247 48074	22T9870	13-Sep-23
6) THERMOMETER WITH PROBE	421504	55000379	22T9904	13-Sep-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 SI UNIT MAINTAINED AT :-
 - NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
 - NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION : ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR $k = 2.303 \text{ RT/F} = 59 \text{ mV/pH}$

mV APPLIED	UUC READING (mV)	CORRECTION (mV)	UUC READING (pH)	UNCERTAINTY OF MEASUREMENT (± mV)	COVERAGE FACTOR k
414.11	414.8	-0.69	-0.171	0.14	2.0
354.95	355.6	-0.65	0.860	0.14	2.0
295.80	296.4	-0.60	1.892	0.14	2.0
236.64	237.2	-0.56	2.922	0.14	2.0
177.48	178.0	-0.52	3.954	0.14	2.0
118.32	118.8	-0.48	4.985	0.14	2.0
59.16	59.7	-0.54	6.016	0.14	2.0
0.00	0.5	-0.50	7.049	0.14	2.0
-59.16	-58.8	-0.36	8.136	0.14	2.0
-118.32	-117.9	-0.42	9.223	0.14	2.0
-177.48	-177.1	-0.38	10.311	0.14	2.0
-236.64	-236.3	-0.34	11.399	0.14	2.0
-295.80	-295.5	-0.30	12.487	0.14	2.0
-354.95	-354.7	-0.25	13.575	0.14	2.0
-414.11	-413.9	-0.21	14.662	0.14	2.0

END OF CALIBRATION REPORT PAGE 2 OF 3



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CERTIFICATE No : 22E9693

PAGE : 3 OF 3

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 (\pm pH)	COVERAGE FACTOR k
4.007	4.007	0.000	3.996	0.012	2.0
7.004	7.006	-0.002	6.944	0.012	2.0
10.016	10.012	0.004	10.194	0.014	2.0

3. DISPLAY UNIT WITH TEMPERATURE

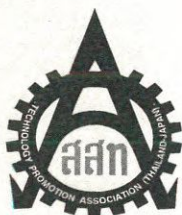
STANDARD READING (°C)	UUC READING (°C)	CORRECTION (°C)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (\pm °C)	COVERAGE FACTOR k
25.003	25.0	0.003	---	0.0085	2.0

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES

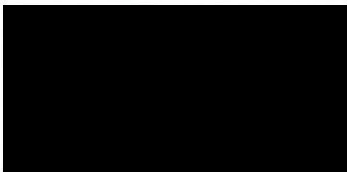

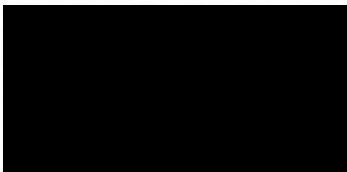
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

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

Cert.No.: 22TW98

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5000-230V
Serial No. :	15B100751
ID No. :	-
Received Date :	20 April 2022
Test Date :	21 April 2022
Reference :	2204-0429WC-1
Submitted by :	S.P.S. Consulting Service Co.,Ltd. 7 Phaholyothin 24, Phaholyothin Road., Jompol, Chatuchak, Bangkok 10900
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	
Approved by :	  Approved Signatory
Issue Date :	25 April 2022



Cert.No.: 22TW98

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	21MM430	21 Sep 2022

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 14J100195

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.14	0.0084

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

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www.qcalibration.com

CERTIFICATE No : 22T0570

REFERENCE No : 63773-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200

SERIAL No : 15110C0498

ID No : DRB 06/59

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

CALIBRATED BY :

CALIBRATION DATE :

21-Jan-22

APPROVED BY :

ISSUED DATE :

21-Jan-22

RECEIVED DATE :

19-Jan-22



QUALITY CALIBRATION CO.,LTD.

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

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

CERTIFICATE No : 22T0570

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR
MANUFACTURER : HACH
ID NUMBER : DRB 06/59
RECEIVED DATE : 19-Jan-22
AMBIENT TEMPERATURE : 23° C ± 1° C

MODEL : DRB 200
SERIAL NUMBER : 15110C0498
CALIBRATION DATE : 21-Jan-22
RELATIVE HUMIDITY : 52 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

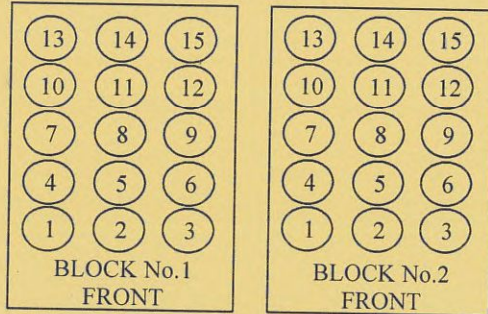
1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT TEMPERATURE RECORDER WITH THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 15 POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE FOUR CORNERS OF THE REACTOR AND PLACED THE EIGHTH THERMOCOUPLE AT THE CENTER OF THE REACTOR.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	8009008	21T6767	10-Jul-22

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 QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



TEMPERATURE MEASUREMENT ACCURACY TEST

Block No.	1	2
Controller temperature (°C)	145	145
Indicating Temperature	145	145
Measured Temperature (°C) at Spread Locations	1	150.5
	2	150.6
	3	149.7
	4	150.2
	5	149.9
	6	150.1
	7	150.1
	8	149.7
	9	150.6
	10	149.6
	11	149.9
	12	149.6
	13	149.7
	14	149.8
	15	149.6
Uncertainty of Measurement(± °C)	0.86	0.86

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

END OF CALIBRATION REPORT

F-G010 R



CERTIFICATE No : 22M2569

REFERENCE No : 64386-3

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

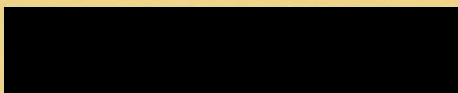
SERIAL No : 36591843

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

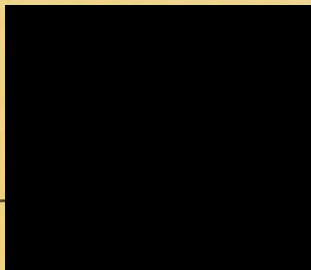
CALIBRATED BY :



CALIBRATION DATE :

11-Mar-22

APPROVED BY :



ISSUED DATE :

17-Mar-22

RECEIVED DATE :

11-Mar-22



CERTIFICATE No : 22M2569

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW
MANUFACTURER : SARTORIUS S/N : 36591843
ID No : BA 09/61 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° C \pm 1° C RELATIVE HUMIDITY : 51 %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 ADJUSTED USING WEIGHT OF QUALITY CALIBRATION TO ADJUST. 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

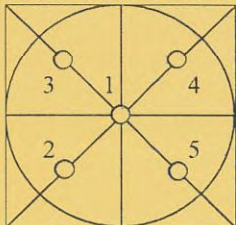
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000048 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.0000	0.0000	0.000078
0.10	0.1000	0.0000	0.000078
0.20	0.2000	0.0000	0.000078
0.50	0.5000	0.0000	0.000079
1.00	1.0000	0.0000	0.000079
2.00	2.0000	0.0000	0.000080
5.00	5.0000	0.0000	0.000081
10.00	10.0000	0.0000	0.000084
20.00	20.0000	0.0000	0.000089
50.00	50.0000	0.0000	0.00011
100.00	100.0000	0.0000	0.00019
200.00	199.9999	0.0001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	99.9999
2	99.9999
3	100.0000
4	99.9999
5	99.9998
OFF-CENTER LOADING	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



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0821/20202

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

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

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

Date : 10/08/2021

ELECTRONIC TEST

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

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

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

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

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

SENSITIVITY TEST: C15. (Area count) = 144,661 Counts.





Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (μ V)	2.94	≤ 50
Baseline Drift (%)	0.24	≤ 1
Sensitivity (S/N for C15)	2,295	$\geq 1,024$

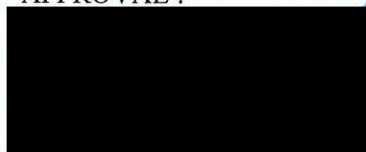
Temperature Specification

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

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	2.53	≤ 5
Retention Time C15(%)	0.04	≤ 0.5

APPROVAL :



Date : 10/08/2021





Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	149,057
C15 Area 2	140,715
C15 Area 3	146,288
C15 Area 4	140,957
C15 Area 5	146,288
C15 Area Average	144,661
* % RSD (< 5 %)	2.53

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by	Sunnarot.	
Date	10/08/2021	





Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	149,057
C15 Area 2	140,715
C15 Area 3	146,288
C15 Area 4	140,957
C15 Area 5	146,288
C15 Area Average	144,661
* % RSD (< 5 %)	2.53

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
[Redacted]		
Date	10/08/2021	



Comments	[Redacted]		
Reviewed by	[Redacted]	Date	10/08/2021





GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0822/20530

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

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

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

Date : 10/08/2022

ELECTRONIC TEST

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

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

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

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

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

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





Detector Sensitivity (FID)

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

Temperature Specification

Temperature	Set	Result	Specification
Column Oven (° C)	80	80	± 5
Injector (° C)	220	220	± 5
Detector (° C)	300	300	± 5
Incubator (° C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

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

APPROVAL :



Date : 10/08/2022





บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

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

Results Integrated System Testing

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

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by	[REDACTED]	
Date	10/08/2022	



Comments	[REDACTED]		
Reviewed by	[REDACTED]		Date 10/08/2022



VARIAN



Results Integrated System Testing

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

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by	[REDACTED]	
Date	10/08/2022	



Comments	[REDACTED]		
Reviewed by	[REDACTED]	Date	10/08/2022



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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

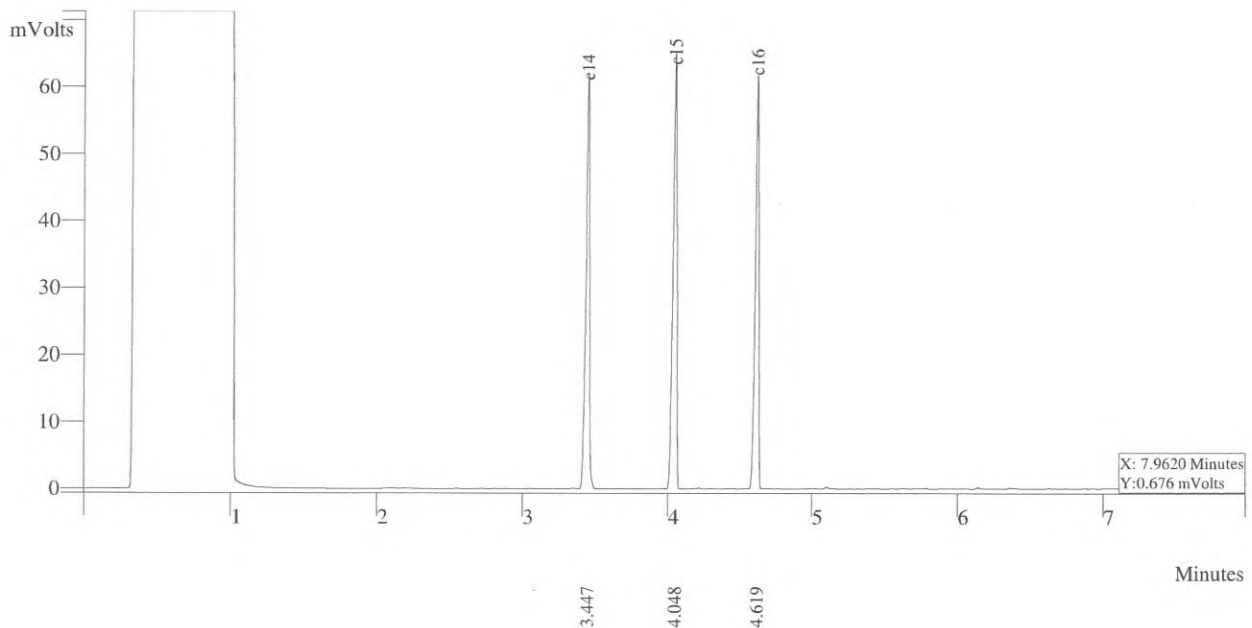
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022001.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.477	112355	VP	1.7
2	c15	33.6834	4.048	117172	VV	1.5
3	c16	34.0178	4.619	118335	VP	1.5
Totals		100.0000		347862		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022002.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.477	112755	VP	1.7
2	c15	33.6834	4.048	119182	VV	1.5
3	c16	34.0178	4.619	118265	VP	1.5
Totals		100.0000		348205		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): suwarot

Injection Date: 16/08/2022

Calc Date: 16/08/2022

Run Time (min): 7.993

Workstation:

Instrument (Inj): Varian Star #1



VARIAN

Run Mode: Analysis

Peak Measurement: Peak Area

Calculation Type: Percent

c:\star\data\tu\cal2022\fid2022003.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.477	112755	VP	1.7
2	c15	33.6834	4.048	117982	VV	1.5
3	c16	34.0178	4.619	118265	VP	1.5
Totals		100.0000		348205		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): suwarot

Injection Date: 16/08/2022

Calc Date: 16/08/2022

Run Time (min): 7.993

Workstation:

Instrument (Inj): Varian Star #1



VARIAN

Run Mode: Analysis

Peak Measurement: Peak Area

Calculation Type: Percent

c:\star\data\tu\cal2022\fid2022004.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.377	113755	VP	1.7
2	c15	33.6834	4.048	118589	VV	1.5
3	c16	34.3178	4.619	128265	VP	1.5
Totals		100.0000		360202		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

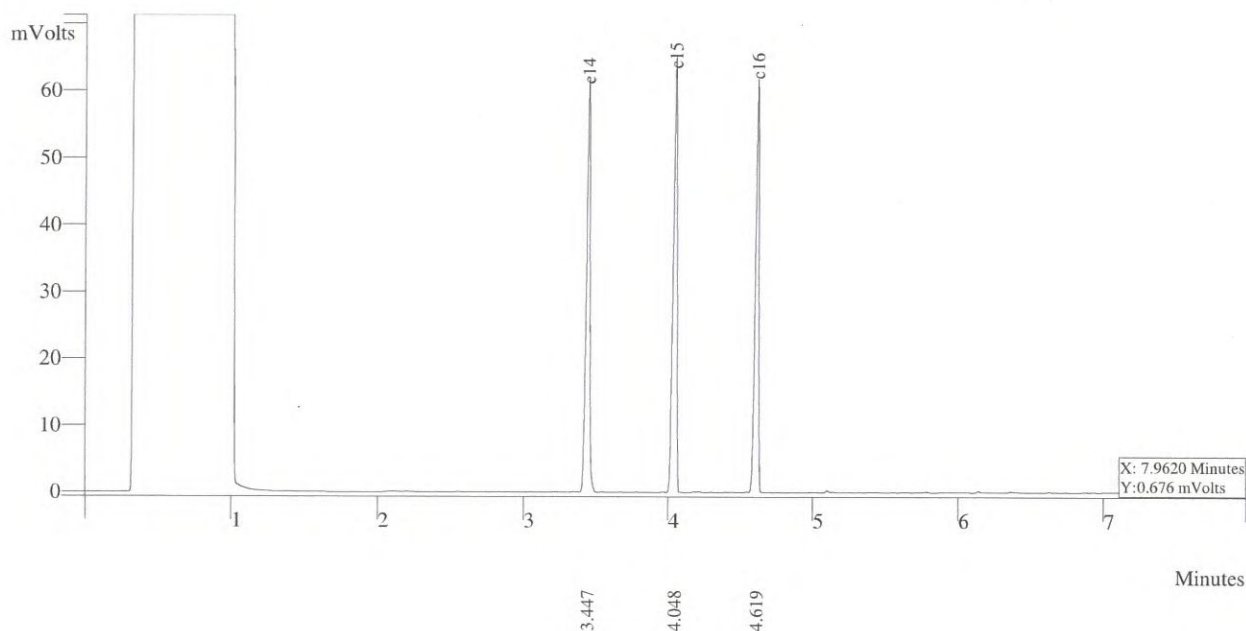
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022005.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.377	115755	VP	1.7
2	c15	33.6834	4.048	117592	VV	1.5
3	c16	34.3178	4.619	138265	VP	1.5
Totals		100.0000		369202		



THAI UNIQUE CO.,LTD.

1 Of 1

GC Clarus 600/680 Preventive Maintenance (PM)

Company Name:	S.P.S. Consulting Service Co.,Ltd		
Address (Instrument Location):	7 Soi Phaholyothin24 Phaholyothin Road, Jompol, Chatuchak, Bangkok, 10900.		
Serial Number:	680S14042502	Service Tag:	N68APSSFEMP
Customer Name (if applicable):		PM number:	1 of 2
Service Engineer Name:		Service Order Number:	WO-01624977
Date PM Performed: (DD-MMM-YYYY)	04-Mar-2022	Next PM Due Date: (DD-MMM-YYYY)	04-Sep-2022

Part Number	Release	Publication Date	
TH09370070	C	August 2016	

Scope

The purpose of this PM is to ensure the continued functionality of the Clarus 600 and Clarus 680 GC 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 #	Software Version	Configuration Notes
Clarus680	680S14042502	Totalchrom6.3.2	
Clarus SQ8T	648N4050804	Turbomass 6.4	
AtomX	US14113002	Tekma AtomX	

Parts Lists

Additional Tools Required for PM				
Part Number (if applicable)	Description	Quantity	Serial #	Calibration Due Date (MM/YY)
LF21-0503	Fluke179 multimeter	1	22460228	04-Nov-2022
Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A				

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.

- ☒ Check incoming AC line voltage for proper levels and grounding.

L-N 220 Volt

L-G 220 Volt

N-G 0.35 Volt

**Neutral to ground not more than 0.5 volts peak to peak*

- ☒ Inspect all gas line filters and traps; Replace if necessary with customer supplied spares.

Carrier gas ☒ Helium ☐ Nitrogen ☐ Hydrogen

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

Detector gas ☒ Air Zero ☒ Hydrogen ☐ Nitrogen ☐ Helium

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

- ☒ Inspect the customer log book and make any appropriate PM entries.

- ☒ Leak check all fittings from the gas source to instrument.

Gas leakage ☒ Pass ☐ Fail Comment _____

- ☒ Perform general inspection of system for cleanliness.

- ☒ Inspect for functional and clean electronic cooling and oven vent fans

Electronic cooling fan ☒ Yes ☐ No

Oven cooling fan ☒ Yes ☐ No

2. Electronic :

- ☒ Check oven temperature. Calibrate if necessary.

Oven temperature set point 150 °C ☒ Pass ☐ Fail

- ☐ Check sub-ambient option. (If installed).

Oven temperature set point 5 °C ☐ Pass ☐ Fail

- ☒ Perform routine maintenance on detector/injector. Replace parts as necessary with customer supplied spares.



- ☒ Check flows, including split flows if applicable. Calibrate if necessary.
Carrier flow Pass
Split flow Pass
- ☒ Check detector gas flows and adjust if necessary.
Detector flow Pass
- ☒ Autosampler installed ☒ Yes ☐ No
Check autosampler sensor for wear and replace if necessary.
Vial sensor Pass
Door sensor Pass
Tower sensor Pass
Plunger sensor Pass
Elevator sensor Pass
- ☒ Remove syringe, manually flush. Replace with customer supplied spare if necessary.
- ☒ Check firmware version. Upgrade to current levels if necessary.
Firmware version 6.5
- ☒ Measure all accessible power supply voltages.
5 Volt Pass
+15 Volt Pass
-15 Volt Pass
24 Volt Pass
- ☒ Record all detector voltage signal.
Detector Channel A 0.91 mV.
Detector Channel B NA mV.

3. Diagnostics Tests:

- ☒ Run instrument diagnostics.
☒ BRAM Pass
☒ EPROM Pass
- ☒ Run Autosampler diagnostics.
☒ BRAM Pass
☒ EPROM Pass

4. 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.
- ☒ Update Logbook.

Additional Comments

Additional Comments Regarding the PM

Review

<i>The preventive maintenance checks and if applicable performance tests for Clarus600/680 GC have been completed.</i>		
<i>This Clarus600/680 GC Pass the preventive maintenance.</i>		
Review of Preventive Maintenance:		
Authorized PerkinElmer Representative: <div style="background-color: black; width: 100px; height: 1.2em; margin-top: 5px;"></div>	<div style="background-color: black; width: 100px; height: 1.2em;"></div>	Date: 04-Mar-2022 <small>(DD-MMM-YYYY)</small>
Authorized Customer Representative:		Date: 04-Mar-2022 <small>(DD-MMM-YYYY)</small>

GC Clarus 600/680 Preventive Maintenance (PM)

Company Name:	S.P.S. Consulting Service Co.,Ltd		
Address (Instrument Location):	7 Soi Phaholyothin24 Phaholyothin Road, Jompol, Chatuchak, Bangkok, 10900.		
Serial Number:	680S14042502	Service Tag:	N68APSSFEMP
Customer Name (if applicable):		PM number:	2 of 2
Service Engineer Name:		Service Order Number:	WO-01841730
Date PM Performed: (DD-MMM-YYYY)	02-Sep-2022	Next PM Due Date: (DD-MMM-YYYY)	02-Mar-2023

Part Number	Release	Publication Date	
TH09370070	C	August 2016	

Scope

The purpose of this PM is to ensure the continued functionality of the Clarus 600 and Clarus 680 GC 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 #	Software Version	Configuration Notes
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Clarus SQ8T	648N4050804	Turbomass 6.4	
AtomX	US14113002	Tekma AtomX	

Parts Lists

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Part Number (if applicable)	Description	Quantity	Serial #	Calibration Due Date (MM/YY)
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Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A				

Procedure Checklist

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

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L-N 220 Volt

L-G 220 Volt

N-G 0.35 Volt

**Neutral to ground not more than 0.5 volts peak to peak*

- ☒ Inspect all gas line filters and traps; Replace if necessary with customer supplied spares.

Carrier gas ☒ Helium ☐ Nitrogen ☐ Hydrogen

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

Detector gas ☒ Air Zero ☒ Hydrogen ☐ Nitrogen ☐ Helium

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

- ☒ Inspect the customer log book and make any appropriate PM entries.

- ☒ Leak check all fittings from the gas source to instrument.

Gas leakage ☒ Pass ☐ Fail Comment _____

- ☒ Perform general inspection of system for cleanliness.

- ☒ Inspect for functional and clean electronic cooling and oven vent fans

Electronic cooling fan ☒ Yes ☐ No

Oven cooling fan ☒ Yes ☐ No

2. Electronic :

- ☒ Check oven temperature. Calibrate if necessary.

Oven temperature set point 150 °C ☒ Pass ☐ Fail

- ☐ Check sub-ambient option. (If installed).

Oven temperature set point 5 °C ☐ Pass ☐ Fail

- ☒ Perform routine maintenance on detector/injector. Replace parts as necessary with customer supplied spares.



- ☒ Check flows, including split flows if applicable. Calibrate if necessary.
Carrier flow Pass
Split flow Pass
- ☒ Check detector gas flows and adjust if necessary.
Detector flow Pass
- ☒ Autosampler installed ☒ Yes ☐ No
Check autosampler sensor for wear and replace if necessary.
Vial sensor Pass
Door sensor Pass
Tower sensor Pass
Plunger sensor Pass
Elevator sensor Pass
- ☒ Remove syringe, manually flush. Replace with customer supplied spare if necessary.
- ☒ Check firmware version. Upgrade to current levels if necessary.
Firmware version 6.5
- ☒ Measure all accessible power supply voltages.
5 Volt Pass
+15 Volt Pass
-15 Volt Pass
24 Volt Pass
- ☒ Record all detector voltage signal.
Detector Channel A 0.89 mV.
Detector Channel B NA mV.

3. Diagnostics Tests:

- ☒ Run instrument diagnostics.
☒ BRAM Pass
☒ EPROM Pass
- ☒ Run Autosampler diagnostics.
☒ BRAM Pass
☒ EPROM Pass

4. 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.
- ☒ Update Logbook.

Additional Comments

Additional Comments Regarding the PM

Review

<p><i>The preventive maintenance checks and if applicable performance tests for Clarus600/680 GC have been completed.</i></p> <p><i>This Clarus600/680 GC Pass the preventive maintenance.</i></p>	
<p>Review of Preventive Maintenance:</p>	
<p>Authorized PerkinElmer Representative:</p> <p>██████████</p>	<p>Date:</p> <p>02-Sep-2022 (DD-MMM-YYYY)</p>
<p>Authorized Customer Representative:</p>	<p>Date:</p> <p>02-Sep-2022 (DD-MMM-YYYY)</p>

เอกสารแนบ 5-5

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศในสถานประกอบการ



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	R ²
B01	SKC	224-PCXR4	262101	04/07/2022	1,000	1,500	2,000	994	1,497	1,998	1.002x - 4.028	1.000
B02	SKC	224-PCXR4	626166	01/07/2022	1,000	1,500	2,000	1,002	1,505	2,001	1.009x - 20.106	0.999
B03	SKC	224-PCXR4	612968	04/07/2022	1,000	1,500	2,000	996	1,494	2,001	1.006x - 12.907	1.000
B04	SKC	224-PCXR4	602804	04/07/2022	1,000	1,500	2,000	1,000	1,502	1,996	1.001x - 2.688	1.000
B05	SKC	224-PCXR4	612693	04/07/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.012x - 22.383	0.999
B06	SKC	224-PCXR4	262188	04/07/2022	1,000	1,500	2,000	996	1,508	2,009	1.020x - 35.110	0.999
B07	SKC	224-PCXR4	626262	01/07/2022	1,000	1,500	2,000	998	1,492	1,995	0.992x + 6.884	1.000
B08	SKC	224-PCXR4	626100	01/07/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.012x - 23.269	0.999
B09	SKC	224-PCXR4	626479	01/07/2022	1,000	1,500	2,000	997	1,490	1,994	0.993x + 3.909	1.000
B10	SKC	224-PCXR4	091950	01/07/2022	1,000	1,500	2,000	993	1,503	2,001	1.017x - 33.950	0.999
B11	SKC	224-PCXR8	564315	04/07/2022	1,000	1,500	2,000	995	1,490	1,999	1.004x - 10.290	1.000
B12	SKC	224-PCXR4	034656	04/07/2022	1,000	1,500	2,000	1,003	1,503	2,003	1.010x - 19.404	0.999
B13	SKC	224-PCXR4	602073	04/07/2022	1,000	1,500	2,000	995	1,500	1,999	1.001x - 3.554	1.000
B14	SKC	224-PCXR4	626313	04/07/2022	1,000	1,500	2,000	999	1,491	1,988	0.992x + 7.243	1.000
B15	SKC	224-PCXR4	626474	04/07/2022	1,000	1,500	2,000	1,003	1,502	2,005	1.013x - 23.723	0.999
B16	SKC	224-PCXR4	626477	01/07/2022	1,000	1,500	2,000	994	1,504	2,001	1.015x - 31.425	0.999
B17	SKC	224-PCXR4	626860	04/07/2022	1,000	1,500	2,000	997	1,495	1,991	0.997x - 0.558	1.000
B18	SKC	224-PCXR4	691484	01/07/2022	1,000	1,500	2,000	1,003	1,500	2,001	1.009x - 18.825	0.999
B19	SKC	224-PCXR4	691599	01/07/2022	1,000	1,500	2,000	995	1,503	1,999	1.005x - 7.985	1.000
B20	SKC	224-PCXR4	691587	01/07/2022	1,000	1,500	2,000	993	1,504	1,999	1.014x - 30.719	0.999
B21	SKC	224-PCXR4	691531	04/07/2022	1,000	1,500	2,000	993	1,499	1,994	1.001x - 7.187	1.000
B22	SKC	224-PCXR4	691654	01/07/2022	1,000	1,500	2,000	1,004	1,501	2,003	1.011x - 19.990	0.999
B23	SKC	224-PCXR4	798393	04/07/2022	1,000	1,500	2,000	993	1,505	2,002	1.017x - 34.763	0.999
B24	SKC	224-PCXR4	626363	01/07/2022	1,000	1,500	2,000	1,000	1,502	2,000	1.011x - 22.826	0.999
B25	SKC	224-PCXR4	798489	04/07/2022	1,000	1,500	2,000	1,001	1,512	2,001	0.998x + 4.850	1.000
B26	SKC	224-PCXR4	798479	05/07/2022	1,000	1,500	2,000	999	1,499	1,993	0.996x + 2.692	1.000
B27	SKC	224-PCXR4	691673	05/07/2022	1,000	1,500	2,000	993	1,503	2,002	1.017x - 32.988	0.999
B28	SKC	224-PCXR4	691570	05/07/2022	1,000	1,500	2,000	1,001	1,500	2,002	1.012x - 23.632	0.999
B29	SKC	224-PCXR4	626472	05/07/2022	1,000	1,500	2,000	999	1,494	1,998	1.002x - 6.856	1.000
B30	SKC	224-PCXR4	691489	05/07/2022	1,000	1,500	2,000	1,004	1,500	2,004	1.013x - 22.910	0.999
B31	SKC	224-PCXR4	691509	04/07/2022	1,000	1,500	2,000	993	1,495	1,998	1.004x - 9.879	1.000
B32	SKC	224-PCXR4	091567	05/07/2022	1,000	1,500	2,000	992	1,504	2,001	1.016x - 32.243	0.999
B33	SKC	224-PCXR4	091756	05/07/2022	1,000	1,500	2,000	994	1,496	1,991	0.996x + 0.634	1.000
B34	SKC	224-PCXR4	612962	05/07/2022	1,000	1,500	2,000	1,002	1,501	2,002	1.011x - 21.693	0.999
B35	SKC	224-PCXR4	602682	04/07/2022	1,000	1,500	2,000	993	1,498	1,996	1.001x - 7.411	1.000
B36	SKC	224-PCXR4	626164	04/07/2022	1,000	1,500	2,000	999	1,495	1,999	1.000x - 4.946	1.000
B37	SKC	224-PCXR4	626256	01/07/2022	1,000	1,500	2,000	994	1,506	2,000	1.014x - 28.892	0.999
B38	SKC	224-PCXR4	626167	04/07/2022	1,000	1,500	2,000	997	1,497	1,996	1.002x - 5.504	1.000
B39	SKC	224-PCXR4	034637	04/07/2022	1,000	1,500	2,000	1,003	1,500	2,002	1.011x - 22.048	0.999
B40	SKC	224-PCXR4	798349	05/07/2022	1,000	1,500	2,000	992	1,505	1,998	1.015x - 32.514	0.999



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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
B41	SKC	224-PCXR4	612669	06/07/2022	1,000	1,500	2,000	998	1,496	1,990	0.994x + 3.749	1.000
B42	SKC	224-PCXR4	626041	06/07/2022	1,000	1,500	2,000	1,003	1,498	1,995	0.990x + 12.946	1.000
B43	SKC	224-PCXR4	034636	06/07/2022	1,000	1,500	2,000	999	1,501	1,992	0.991x + 10.805	1.000
B44	SKC	224-PCXR8	529341	06/07/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.012x - 21.857	0.999
B45	SKC	224-PCXR8	529594	04/07/2022	1,000	1,500	2,000	997	1,498	1,989	0.994x + 4.563	1.000
B46	SKC	224-PCXR8	566743	01/07/2022	1,000	1,500	2,000	994	1,504	2,002	1.016x - 33.363	0.999
B47	SKC	224-PCXR8	566747	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 25.000	0.999
B48	SKC	224-PCXR8	566753	04/07/2022	1,000	1,500	2,000	999	1,494	1,998	0.999x - 2.194	1.000
B49	SKC	224-PCXR8	566780	04/07/2022	1,000	1,500	2,000	1,003	1,502	2,003	1.012x - 22.626	0.999
B50	SKC	224-PCXR8	500400	04/07/2022	1,000	1,500	2,000	1,002	1,495	2,002	1.001x - 3.458	1.000
B51	SKC	224-PCXR8	500363	04/07/2022	1,000	1,500	2,000	995	1,504	2,000	1.012x - 26.388	0.999
B52	SKC	224-PCXR8	093186	04/07/2022	1,000	1,500	2,000	995	1,497	1,994	0.997x - 1.360	1.000
B53	SKC	224-PCXR8	707670	04/07/2022	1,000	1,500	2,000	1,002	1,499	2,002	1.010x - 20.947	0.999
B54	SKC	224-PCXR3	509821	01/07/2022	1,000	1,500	2,000	993	1,501	2,001	1.016x - 33.878	0.999
B55	SKC	224-PCXR3	510710	01/07/2022	1,000	1,500	2,000	1,000	1,494	1,993	0.993x + 5.432	1.000
B56	SKC	224-PCXR3	511450	01/07/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.011x - 20.804	0.999
B57	SKC	224-PCXR3	510798	01/07/2022	1,000	1,500	2,000	997	1,493	1,998	1.001x - 3.199	1.000
B58	SKC	224-PCXR3	509852	05/07/2022	1,000	1,500	2,000	1,001	1,498	1,999	1.007x - 19.033	0.999
B59	SKC	224-PCXR3	509862	05/07/2022	1,000	1,500	2,000	996	1,503	1,994	0.997x + 3.115	1.000
B60	SKC	224-PCXR3	512655	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,003	1.012x - 23.691	0.999
B61	SKC	224-PCXR3	503915	04/07/2022	1,000	1,500	2,000	994	1,489	1,998	1.004x - 11.866	1.000
B62	SKC	224-PCXR3	505975	04/07/2022	1,000	1,500	2,000	999	1,494	1,996	0.997x - 0.104	1.000
B63	SKC	224-PCXR3	511432	01/07/2022	1,000	1,500	2,000	991	1,501	1,999	1.017x - 35.541	0.999
B64	SKC	224-PCXR3	508302	01/07/2022	1,000	1,500	2,000	997	1,493	1,989	0.992x + 5.947	1.000
B65	SKC	224-PCXR3	508310	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,003	1.012x - 22.949	0.999
B66	SKC	224-PCXR3	509861	05/07/2022	1,000	1,500	2,000	1,002	1,491	1,991	0.988x + 13.425	1.000
B67	SKC	224-PCXR3	506295	01/07/2022	1,000	1,500	2,000	993	1,507	2,004	1.017x - 32.945	0.999
B68	SKC	224-PCXR3	505872	01/07/2022	1,000	1,500	2,000	1,002	1,491	1,997	0.994x + 5.755	1.000
B69	SKC	224-PCXR3	508375	01/07/2022	1,000	1,500	2,000	1,001	1,500	2,000	1.010x - 21.569	0.999
B70	SKC	224-PCXR3	510623	04/07/2022	1,000	1,500	2,000	992	1,503	1,997	1.002x - 6.533	1.000
B71	SKC	224-PCXR3	508367	05/07/2022	1,000	1,500	2,000	990	1,506	2,002	1.018x - 37.184	0.999
B72	SKC	224-PCXR3	505977	05/07/2022	1,000	1,500	2,000	1,001	1,498	1,993	0.993x + 5.652	1.000
B73	SKC	224-PCXR3	512606	04/07/2022	1,000	1,500	2,000	1,001	1,501	2,005	1.013x - 24.278	0.999
B74	SKC	224-PCXR3	505993	01/07/2022	1,000	1,500	2,000	996	1,495	1,994	1.000x - 4.682	1.000
B75	SKC	224-PCXR3	509820	01/07/2022	1,000	1,500	2,000	996	1,499	1,990	0.994x + 3.625	1.000
B76	SKC	224-PCXR3	509811	04/07/2022	1,000	1,500	2,000	993	1,498	1,998	1.007x - 14.602	1.000
B77	SKC	224-PCXR3	508301	04/07/2022	1,000	1,500	2,000	1,000	1,501	2,004	1.014x - 26.842	0.999
B78	SKC	224-PCXR3	510677	04/07/2022	1,000	1,500	2,000	996	1,503	1,998	1.012x - 27.121	0.999
B79	SKC	224-PCXR3	510920	04/07/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x - 3.506	1.000



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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
B80	SKC	224-PCXR3	504569	01/07/2022	1,000	1,500	2,000	1,003	1,499	2,001	1.011x - 21.873	0.999
B81	SKC	224-PCXR3	503480	01/07/2022	1,000	1,500	2,000	996	1,499	2,000	1.013x - 28.489	0.999
B82	SKC	224-PCXR3	505673	04/07/2022	1,000	1,500	2,000	993	1,499	1,996	1.001x - 6.102	1.000
B83	SKC	224-PCXR3	510785	05/07/2022	1,000	1,500	2,000	1,000	1,499	2,002	1.012x - 24.266	0.999
B84	SKC	224-PCXR3	508333	04/07/2022	1,000	1,500	2,000	997	1,495	1,991	0.996x + 1.460	1.000
B85	SKC	224-PCXR3	505757	01/07/2022	1,000	1,500	2,000	993	1,502	1,998	1.013x - 29.678	0.999
B86	SKC	224-PCXR3	512625	01/07/2022	1,000	1,500	2,000	1,003	1,502	2,004	1.012x - 22.383	0.999
B87	SKC	224-PCXR3	504324	06/07/2022	1,000	1,500	2,000	998	1,496	2,000	1.001x - 2.385	1.000
B88	SKC	224-PCXR3	508307	06/07/2022	1,000	1,500	2,000	997	1,498	1,994	0.997x + 1.093	1.000
B89	SKC	224-PCXR3	509860	06/07/2022	1,000	1,500	2,000	1,000	1,500	2,003	1.014x - 25.845	0.999
B90	SKC	224-PCXR3	508366	06/07/2022	1,000	1,500	2,000	992	1,502	2,000	1.015x - 32.055	0.999
B91	SKC	224-PCXR3	510919	04/07/2022	1,000	1,500	2,000	1,000	1,498	1,996	0.999x - 0.694	1.000
B92	SKC	224-PCXR3	510987	04/07/2022	1,000	1,500	2,000	1,002	1,501	2,004	1.013x - 23.312	0.999
B93	SKC	224-PCXR3	509845	05/07/2022	1,000	1,500	2,000	1,000	1,496	1,998	1.000x - 2.501	1.000
B94	SKC	224-PCXR8	A127871	05/07/2022	1,000	1,500	2,000	1,000	1,500	2,002	1.014x - 25.765	0.999
B95	SKC	224-PCXR8	A127921	05/07/2022	1,000	1,500	2,000	992	1,502	2,001	1.016x - 33.052	0.999
B96	SKC	224-PCXR8	A127942	05/07/2022	1,000	1,500	2,000	996	1,498	1,996	1.002x - 5.799	1.000
B97	SKC	224-PCXR8	A127955	05/07/2022	1,000	1,500	2,000	1,003	1,501	2,003	1.012x - 21.717	0.999
B98	SKC	224-PCXR8	A127956	05/07/2022	1,000	1,500	2,000	1,000	1,498	1,998	0.999x - 1.863	0.999



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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	01/07/2022	1,000	1,500	2,000	993	1,508	2,004	1.020x - 38.744	0.998
R02	SKC	224-PCXR4	626450	01/07/2022	1,000	2,000	3,000	998	1,499	1,990	0.989x + 12.348	1.000
R03	SKC	224-PCXR4	691592	04/07/2022	1,000	1,500	2,000	1,003	1,500	2,004	1.012x - 22.080	0.999
R04	SKC	224-PCXR4	691672	01/07/2022	1,000	1,500	2,000	996	1,493	1,993	0.997x - 1.763	1.000
R05	SKC	224-PCXR4	798470	04/07/2022	1,000	1,500	2,000	994	1,506	1,999	1.013x - 30.077	0.999
R06	SKC	224-PCXR4	798456	04/07/2022	1,000	1,500	2,000	994	1,498	1,994	1.002x - 7.319	1.000
R07	SKC	224-PCXR4	798480	04/07/2022	1,000	1,500	2,000	994	1,490	2,000	1.008x - 17.031	1.000
R08	SKC	224-PCXR4	883215	05/07/2022	1,000	1,500	2,000	1,001	1,502	2,005	1.015x - 26.148	0.999
R09	SKC	224-PCXR4	034650	01/07/2022	1,000	1,500	2,000	991	1,504	2,002	1.018x - 36.777	0.999
R10	SKC	224-PCXR4	091765	04/07/2022	1,000	1,500	2,000	996	1,512	1,994	1.000x + 0.100	1.000
R11	SKC	224-PCXR4	091763	01/07/2022	1,000	1,500	2,000	1,000	1,499	2,002	1.013x - 25.598	0.999
R12	SKC	224-PCXR4	091568	04/07/2022	1,000	1,500	2,000	997	1,501	1,999	1.001x - 4.866	1.000
R13	SKC	224-PCXR4	091638	04/07/2022	1,000	1,500	2,000	1,002	1,498	1,993	0.991x + 10.115	1.000
R14	SKC	224-PCXR4	091764	04/07/2022	1,000	1,500	2,000	994	1,502	1,999	1.013x - 29.654	0.999
R15	SKC	224-PCXR8	529457	01/07/2022	1,000	1,500	2,000	1,001	1,500	2,004	1.013x - 25.263	0.999
R16	SKC	224-PCXR8	529643	01/07/2022	1,000	1,500	2,000	998	1,497	1,994	0.997x - 0.379	1.000
R17	SKC	224-PCXR8	529645	01/07/2022	1,000	1,500	2,000	994	1,509	2,000	1.014x - 30.173	0.999
R18	SKC	224-PCXR8	566756	04/07/2022	1,000	1,500	2,000	991	1,496	1,998	1.001x - 6.880	1.000
R19	SKC	224-PCXR8	566802	01/07/2022	1,000	1,500	2,000	1,003	1,499	2,000	1.010x - 19.831	0.999
R20	SKC	224-PCXR8	529089	01/07/2022	1,000	1,500	2,000	990	1,500	2,003	1.020x - 40.235	0.999
R21	SKC	224-PCXR8	665728	04/07/2022	1,000	1,500	2,000	998	1,493	1,999	1.001x - 5.604	1.000
R22	SKC	224-PCXR8	707444	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.011x - 21.494	0.999
R23	SKC	224-PCXR8	761067	04/07/2022	1,000	1,500	2,000	998	1,494	1,992	0.994x + 2.896	1.000
R24	SKC	224-PCXR8	707893	01/07/2022	1,000	1,500	2,000	996	1,505	2,000	1.013x - 27.843	0.999
R25	SKC	224-PCXR8	761052	04/07/2022	1,000	1,500	2,000	998	1,500	1,993	0.993x + 6.633	1.000
R26	SKC	224-PCXR8	707956	04/07/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.298	0.999
R27	SKC	224-PCXR8	707398	01/07/2022	1,000	1,500	2,000	996	1,503	2,001	1.013x - 28.844	0.999
R28	SKC	224-PCXR8	707481	04/07/2022	1,000	1,500	2,000	1,004	1,500	2,003	1.010x - 19.727	0.999
R29	SKC	224-PCXR8	707402	01/07/2022	1,000	1,500	2,000	1,005	1,491	1,991	0.988x + 13.928	1.000
R30	SKC	224-PCXR8	093811	01/07/2022	1,000	1,500	2,000	998	1,495	1,994	0.998x - 1.149	1.000
R31	SKC	224-PCXR8	093183	01/07/2022	1,000	1,500	2,000	1,001	1,501	2,001	1.012x - 23.161	0.999
R32	SKC	224-PCXR8	671950	04/07/2022	1,000	1,500	2,000	1,000	1,498	1,994	0.993x + 7.961	1.000
R33	SKC	224-PCXR4	626254	04/07/2022	1,000	1,500	2,000	992	1,502	1,999	1.017x - 34.540	0.999
R34	SKC	224-PCXR4	626131	04/07/2022	1,000	1,500	2,000	1,002	1,498	2,004	1.013x - 25.091	0.999
R35	SKC	224-PCXR8	707460	04/07/2022	1,000	1,500	2,000	998	1,498	1,995	0.994x + 5.472	1.000
R36	SKC	224-PCXR8	707446	01/07/2022	1,000	1,500	2,000	1,003	1,500	2,001	1.009x - 19.272	0.999
R37	SKC	224-PCXR8	707432	01/07/2022	1,000	1,500	2,000	999	1,499	1,998	0.998x + 0.243	1.000
R38	SKC	224-PCXR8	707349	01/07/2022	1,000	1,500	2,000	996	1,500	2,002	1.015x - 32.039	0.999
R39	SKC	224-PCXR8	761095	04/07/2022	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.333	1.000



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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 \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	R ²
R40	SKC	224-PCXR4	612753	04/07/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.012x – 22.926	0.999
R41	SKC	224-PCXR4	626140	04/07/2022	1,000	1,500	2,000	991	1,509	2,002	1.018x – 34.715	0.999
R42	SKC	224-PCXR4	626463	01/07/2022	1,000	1,500	2,000	995	1,493	2,000	1.004x – 7.949	1.000
R43	SKC	224-PCXR4	626129	04/07/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.012x – 22.176	0.999
R44	SKC	224-PCXR4	602753	04/07/2022	1,000	1,500	2,000	1,002	1,495	1,993	0.996x + 1.332	1.000
R45	SKC	224-PCXR4	626137	04/07/2022	1,000	1,500	2,000	992	1,505	2,002	1.019x – 37.527	0.999



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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	R ²
B01	SKC	224-PCXR4	262101	06/10/2022	1,000	1,500	2,000	994	1,497	1,998	1.001x - 3.789	1.000
B02	SKC	224-PCXR4	626166	03/10/2022	1,000	1,500	2,000	1,002	1,505	2,001	1.009x - 19.707	0.999
B03	SKC	224-PCXR4	612968	03/10/2022	1,000	1,500	2,000	996	1,494	2,001	1.006x - 12.308	1.000
B04	SKC	224-PCXR4	602804	03/10/2022	1,000	1,500	2,000	1,000	1,502	2,000	1.004x - 5.919	1.000
B05	SKC	224-PCXR4	612693	06/10/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.012x - 22.622	0.999
B06	SKC	224-PCXR4	262188	06/10/2022	1,000	1,500	2,000	995	1,507	1,999	1.005x - 11.738	1.000
B07	SKC	224-PCXR4	626262	04/10/2022	1,000	1,500	2,000	998	1,492	1,995	0.993x + 6.405	1.000
B08	SKC	224-PCXR4	626100	04/10/2022	1,000	1,500	2,000	1,002	1,499	2,003	1.013x - 24.18	0.999
B09	SKC	224-PCXR4	626479	06/10/2022	1,000	1,500	2,000	996	1,490	1,994	0.994x + 1.675	1.000
B10	SKC	224-PCXR4	091950	03/10/2022	1,000	1,500	2,000	993	1,503	2,001	1.017x - 34.588	0.999
B11	SKC	224-PCXR8	564315	06/10/2022	1,000	1,500	2,000	994	1,490	2,003	1.007x - 14.438	1.000
B12	SKC	224-PCXR4	034656	03/10/2022	1,000	1,500	2,000	1,003	1,503	2,003	1.010x - 19.005	0.999
B13	SKC	224-PCXR4	602073	03/10/2022	1,000	1,500	2,000	995	1,500	1,993	0.997x + 2.708	1.000
B14	SKC	224-PCXR4	626313	03/10/2022	1,000	1,500	2,000	998	1,491	1,988	0.992x + 6.007	1.000
B15	SKC	224-PCXR4	626474	03/10/2022	1,000	1,500	2,000	1,003	1,502	2,005	1.003x - 10.123	0.999
B16	SKC	224-PCXR4	626477	03/10/2022	1,000	1,500	2,000	993	1,504	2,001	1.015x - 31.624	0.999
B17	SKC	224-PCXR4	626860	03/10/2022	1,000	1,500	2,000	997	1,494	1,991	0.997x - 0.239	1.000
B18	SKC	224-PCXR4	691484	03/10/2022	1,000	1,500	2,000	1,003	1,500	2,001	1.008x - 16.073	0.999
B19	SKC	224-PCXR4	691599	03/10/2022	1,000	1,500	2,000	993	1,503	2,000	1.005x - 8.623	1.000
B20	SKC	224-PCXR4	691587	03/10/2022	1,000	1,500	2,000	991	1,504	1,999	1.016x - 33.631	0.999
B21	SKC	224-PCXR4	691531	06/10/2022	1,000	1,500	2,000	993	1,500	1,994	1.001x - 6.669	1.000
B22	SKC	224-PCXR4	691654	04/10/2022	1,000	1,500	2,000	1,003	1,501	2,003	1.011x - 20.429	0.999
B23	SKC	224-PCXR4	798393	04/10/2022	1,000	1,500	2,000	993	1,505	2,002	1.018x - 34.843	0.999
B24	SKC	224-PCXR4	626363	06/10/2022	1,000	1,500	2,000	999	1,502	2,000	1.012x - 23.225	0.999
B25	SKC	224-PCXR4	798489	06/10/2022	1,000	1,500	2,000	1,001	1,512	2,001	0.998x + 5.049	1.000
B26	SKC	224-PCXR4	798479	06/10/2022	1,000	1,500	2,000	999	1,499	1,993	0.996x + 2.892	1.000
B27	SKC	224-PCXR4	691673	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1.011x - 22.778	0.999
B28	SKC	224-PCXR4	691570	04/10/2022	1,000	1,500	2,000	1,001	1,500	2,002	1.007x - 13.301	1.000
B29	SKC	224-PCXR4	626472	06/10/2022	1,000	1,500	2,000	1,000	1,496	1,998	1.002x - 5.261	1.000
B30	SKC	224-PCXR4	691489	03/10/2022	1,000	1,500	2,000	1,007	1,500	2,004	1.010x - 18.482	0.999
B31	SKC	224-PCXR4	691509	03/10/2022	1,000	1,500	2,000	993	1,497	1,998	1.004x - 8.882	1.000
B32	SKC	224-PCXR4	091567	03/10/2022	1,000	1,500	2,000	992	1,504	2,001	1.007x - 15.930	1.000
B33	SKC	224-PCXR4	091756	06/10/2022	1,000	1,500	2,000	994	1,496	1,991	0.996x + 0.714	1.000
B34	SKC	224-PCXR4	612962	03/10/2022	1,000	1,500	2,000	1,002	1,501	2,001	1.009x - 17.944	0.999
B35	SKC	224-PCXR4	602682	03/10/2022	1,000	1,500	2,000	993	1,498	1,995	1.001x - 7.331	1.000
B36	SKC	224-PCXR4	626164	06/10/2022	1,000	1,500	2,000	999	1,495	1,999	1.000x - 4.866	1.000
B37	SKC	224-PCXR4	626256	06/10/2022	1,000	1,500	2,000	994	1,506	1,999	1.013x - 28.214	0.999
B38	SKC	224-PCXR4	626167	06/10/2022	1,000	1,500	2,000	997	1,496	1,996	1.002x - 6.342	1.000
B39	SKC	224-PCXR4	034637	06/10/2022	1,000	1,500	2,000	1,006	1,500	2,001	1.008x - 16.624	0.999
B40	SKC	224-PCXR4	798349	05/10/2022	1,000	1,500	2,000	994	1,505	1,998	1.014x - 29.642	0.999



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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
B41	SKC	224-PCXR4	612669	05/10/2022	1,000	1,500	2,000	998	1,496	1,990	0.994x + 3.271	1.000
B42	SKC	224-PCXR4	626041	06/10/2022	1,000	1,500	2,000	1,005	1,498	1,994	0.988x + 15.619	1.000
B43	SKC	224-PCXR4	034636	06/10/2022	1,000	1,500	2,000	999	1,501	1,992	0.991x + 10.565	1.000
B44	SKC	224-PCXR8	529341	06/10/2022	1,000	1,500	2,000	1,002	1,502	2,002	1.011x - 21.418	0.999
B45	SKC	224-PCXR8	529594	06/10/2022	1,000	1,500	2,000	998	1,498	1,989	0.993x + 5.959	1.000
B46	SKC	224-PCXR8	566743	06/10/2022	1,000	1,500	2,000	994	1,504	2,002	1.016x - 32.885	0.999
B47	SKC	224-PCXR8	566747	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.960	0.999
B48	SKC	224-PCXR8	566753	03/10/2022	1,000	1,500	2,000	999	1,494	1,998	0.999x - 2.114	1.000
B49	SKC	224-PCXR8	566780	05/10/2022	1,000	1,500	2,000	1,003	1,502	2,003	1.012x - 22.706	0.999
B50	SKC	224-PCXR8	500400	06/10/2022	1,000	1,500	2,000	1,001	1,495	2,002	1.001x - 3.737	1.000
B51	SKC	224-PCXR8	500363	06/10/2022	1,000	1,500	2,000	995	1,504	1,999	1.011x - 25.590	0.999
B52	SKC	224-PCXR8	093186	03/10/2022	1,000	1,500	2,000	995	1,496	1,994	0.997x - 1.161	1.000
B53	SKC	224-PCXR8	707670	03/10/2022	1,000	1,500	2,000	1,002	1,500	2,002	1.010x - 20.668	0.999
B54	SKC	224-PCXR3	509821	03/10/2022	1,000	1,500	2,000	993	1,500	2,001	1.017x - 34.516	0.999
B55	SKC	224-PCXR3	510710	03/10/2022	1,000	1,500	2,000	999	1,494	1,994	0.995x + 2.521	1.000
B56	SKC	224-PCXR3	511450	03/10/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.004x - 7.562	1.000
B57	SKC	224-PCXR3	510798	06/10/2022	1,000	1,500	2,000	997	1,492	1,998	0.996x +1.109	1.000
B58	SKC	224-PCXR3	509852	06/10/2022	1,000	1,500	2,000	1,000	1,498	1,999	1.007x - 19.113	0.999
B59	SKC	224-PCXR3	509862	03/10/2022	1,000	1,500	2,000	996	1,503	1,994	0.997x + 2.955	1.000
B60	SKC	224-PCXR3	512655	03/10/2022	1,000	1,500	2,000	1,005	1,500	2,003	1.010x - 19.862	0.999
B61	SKC	224-PCXR3	503915	04/10/2022	1,000	1,500	2,000	994	1,489	1,998	1.004x - 11.786	1.000
B62	SKC	224-PCXR3	505975	03/10/2022	1,000	1,500	2,000	999	1,494	1,996	0.997x - 0.064	1.000
B63	SKC	224-PCXR3	511432	03/10/2022	1,000	1,500	2,000	991	1,501	1,999	1.017x - 35.461	0.999
B64	SKC	224-PCXR3	508302	03/10/2022	1,000	1,500	2,000	997	1,492	1,989	0.992x + 6.266	1.000
B65	SKC	224-PCXR3	508310	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,003	1.011x - 21.992	0.999
B66	SKC	224-PCXR3	509861	06/10/2022	1,000	1,500	2,000	1,002	1,491	1,991	0.988x + 13.904	1.000
B67	SKC	224-PCXR3	506295	06/10/2022	1,000	1,500	2,000	993	1,508	2,004	1.017x - 32.785	0.999
B68	SKC	224-PCXR3	505872	05/10/2022	1,000	1,500	2,000	1,002	1,491	1,997	0.994x + 5.237	1.000
B69	SKC	224-PCXR3	508375	05/10/2022	1,000	1,500	2,000	1,001	1,499	2,000	1.010x - 21.330	0.999
B70	SKC	224-PCXR3	510623	05/10/2022	1,000	1,500	2,000	992	1,503	1,997	1.002x - 6.054	1.000
B71	SKC	224-PCXR3	508367	05/10/2022	1,000	1,500	2,000	990	1,506	2,002	1.018x - 37.025	0.999
B72	SKC	224-PCXR3	505977	05/10/2022	1,000	1,500	2,000	1,001	1,498	1,993	0.993x + 5.731	1.000
B73	SKC	224-PCXR3	512606	05/10/2022	1,000	1,500	2,000	1,001	1,501	2,005	1.014x - 24.397	0.999
B74	SKC	224-PCXR3	505993	05/10/2022	1,000	1,500	2,000	996	1,495	1,994	0.999x - 4.284	1.000
B75	SKC	224-PCXR3	509820	05/10/2022	1,000	1,500	2,000	996	1,498	1,990	0.995x + 2.987	1.000
B76	SKC	224-PCXR3	509811	03/10/2022	1,000	1,500	2,000	993	1,498	1,998	1.006x - 14.003	1.000
B77	SKC	224-PCXR3	508301	06/10/2022	1,000	1,500	2,000	1,000	1,501	2,003	1.014x - 25.845	0.999
B78	SKC	224-PCXR3	510677	06/10/2022	1,000	1,500	2,000	996	1,503	1,999	1.012x - 27.321	0.999
B79	SKC	224-PCXR3	510920	06/10/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x - 3.905	1.000



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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	R ²
B80	SKC	224-PCXR3	504569	06/10/2022	1,000	1,500	2,000	1,003	1,499	2,002	1.011x - 22.072	0.999
B81	SKC	224-PCXR3	503480	06/10/2022	1,000	1,500	2,000	996	1,499	2,000	1.014x - 29.407	0.999
B82	SKC	224-PCXR3	505673	03/10/2022	1,000	1,500	2,000	994	1,498	1,996	1.001x - 4.866	1.000
B83	SKC	224-PCXR3	510785	03/10/2022	1,000	1,500	2,000	1,000	1,499	2,002	1.012x - 23.827	0.999
B84	SKC	224-PCXR3	508333	03/10/2022	1,000	1,500	2,000	997	1,495	1,991	0.996x - 1.819	1.000
B85	SKC	224-PCXR3	505757	03/10/2022	1,000	1,500	2,000	994	1,502	1,998	1.013x - 28.362	0.999
B86	SKC	224-PCXR3	512625	05/10/2022	1,000	1,500	2,000	1,003	1,503	2,004	1.012x - 22.064	0.999
B87	SKC	224-PCXR3	504324	05/10/2022	1,000	1,500	2,000	998	1,496	2,000	1.001x - 2.186	1.000
B88	SKC	224-PCXR3	508307	05/10/2022	1,000	1,500	2,000	997	1,498	1,994	0.997x + 1.093	1.000
B89	SKC	224-PCXR3	509860	05/10/2022	1,000	1,500	2,000	1,000	1,500	2,003	1.014x - 25.885	0.999
B90	SKC	224-PCXR3	508366	05/10/2022	1,000	1,500	2,000	992	1,503	1,999	1.015x - 31.616	0.999
B91	SKC	224-PCXR3	510919	05/10/2022	1,000	1,500	2,000	1,000	1,498	1,996	1.000x - 2.608	1.000
B92	SKC	224-PCXR3	510987	05/10/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.013x - 24.030	0.999
B93	SKC	224-PCXR3	509845	05/10/2022	1,000	1,500	2,000	998	1,496	1,998	1.002x - 6.609	1.000
B94	SKC	224-PCXR8	A127871	03/10/2022	1,000	1,500	2,000	1,000	1,500	2,002	1.013x - 25.526	0.999
B95	SKC	224-PCXR8	A127921	03/10/2022	1,000	1,500	2,000	992	1,502	2,001	1.015x - 30.265	0.999
B96	SKC	224-PCXR8	A127942	03/10/2022	1,000	1,500	2,000	996	1,498	1,994	1.000x - 3.258	1.000
B97	SKC	224-PCXR8	A127955	03/10/2022	1,000	1,500	2,000	1,003	1,501	2,003	1.013x - 23.258	0.999
B98	SKC	224-PCXR8	A127956	03/10/2022	1,000	1,500	2,000	1,000	1,498	1,997	1.002x - 7.256	1.000

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
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



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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	R ²
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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Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

S/N : 136164											
Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-R01	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	503.3	992.4	1978.7	0.999x - 3.250	0.999
H-R02	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	501.2	995.3	1985.7	1.002x - 4.979	1.000
H-R03	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	502.5	989.9	1996.9	0.993x + 3.105	1.000
H-R04	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	496.4	989.6	2019.5	1.009x - 13.684	1.000
H-R05	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	497.2	990.3	1988.1	1.003x - 8.079	1.000
H-R06	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	504.6	992.4	1979.4	1.000x - 3.305	0.999



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

Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

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



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

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

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



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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	R²
L-R01	Dwyer	VFA-21	04/10/2022	50	100	200	50.2	101.0	203.9	0.987x + 2.546	1.000
L-R02	Dwyer	VFA-21	05/10/2022	50	100	200	50.1	101.3	200.5	1.007x – 0.870	0.999
L-R03	Dwyer	VFA-21	06/10/2022	50	100	200	50.1	99.8	202.3	1.017x – 1.042	1.000
L-R04	Dwyer	VFA-21	06/10/2022	50	100	200	50.2	100.9	201.0	1.008x – 1.004	0.999
L-R05	Dwyer	VFA-21	05/10/2022	50	100	200	50.2	100.8	203.0	0.990x + 1.973	1.000
L-R06	Dwyer	VFA-21	04/10/2022	50	100	200	50.2	99.1	201.5	1.004x – 0.364	1.000



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0821/20202

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

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

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

Date : 10/08/2021

ELECTRONIC TEST

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

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

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

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

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

SENSITIVITY TEST: C15. (Area count) = 144,661 Counts.





Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (µV)	2.94	≤ 50
Baseline Drift (%)	0.24	≤ 1
Sensitivity (S/N for C15)	1,295	≥ 1,024

Temperature Specification

Temperature	Set	Result	Specification
Column Oven (°C)	80	80	± 5
Injector (°C)	220	220	± 5
Detector (°C)	300	300	± 5
Incubator (°C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	2.53	≤ 5
Retention Time C15(%)	0.04	≤ 0.5

APPROVAL :

Signature: [REDACTED]

Engineer [REDACTED]



Date : 10/08/2021



**Results Integrated System Testing**

Checklist Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	149,057
C15 Area 2	140,715
C15 Area 3	146,288
C15 Area 4	140,957
C15 Area 5	146,288
C15 Area Average	144,661
* % RSD (< 5 %)	2.53

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by	[REDACTED]	
Date	10/08/2021	

Comments	[REDACTED]		
Reviewed by	[REDACTED]		Date 10/08/2021





Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	149,057
C15 Area 2	140,715
C15 Area 3	146,288
C15 Area 4	140,957
C15 Area 5	146,288
C15 Area Average	144,661
* % RSD (< 5 %)	2.53

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performed by	[REDACTED]	
Date	10/08/2021	



Comments	[REDACTED]		
Reviewed by	[REDACTED]		Date 10/08/2021





GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0822/20530

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

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

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

Date : 10/08/2022

ELECTRONIC TEST

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

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

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

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

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

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





Detector Sensitivity (FID)

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

Temperature Specification

Temperature	Set	Result	Specification
Column Oven (° C)	80	80	± 5
Injector (° C)	220	220	± 5
Detector (° C)	300	300	± 5
Incubator (° C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

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

APPROVAL :

Signature: _____

Engineer _____

Date : 10/08/2022





บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

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

Results Integrated System Testing

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

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by	[REDACTED]	
Date	10/08/2022	



Comments	-		
Reviewed by	[REDACTED]		Date 10/08/2022



VARIAN



Results Integrated System Testing

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

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

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

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

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by	[REDACTED]	
Date	10/08/2022	



Comments	[REDACTED]		
Reviewed by	[REDACTED]		Date 10/08/2022



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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

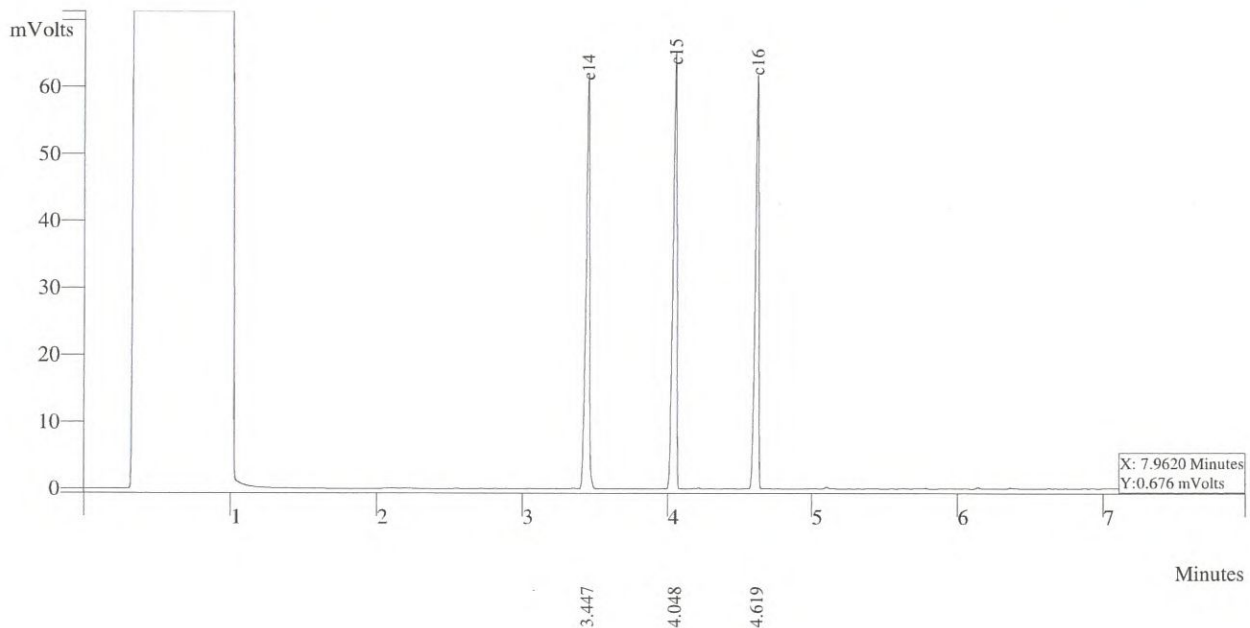
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022001.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.477	112355	VP	1.7
2	c15	33.6834	4.048	117172	VV	1.5
3	c16	34.0178	4.619	118335	VP	1.5
Totals		100.0000		347862		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

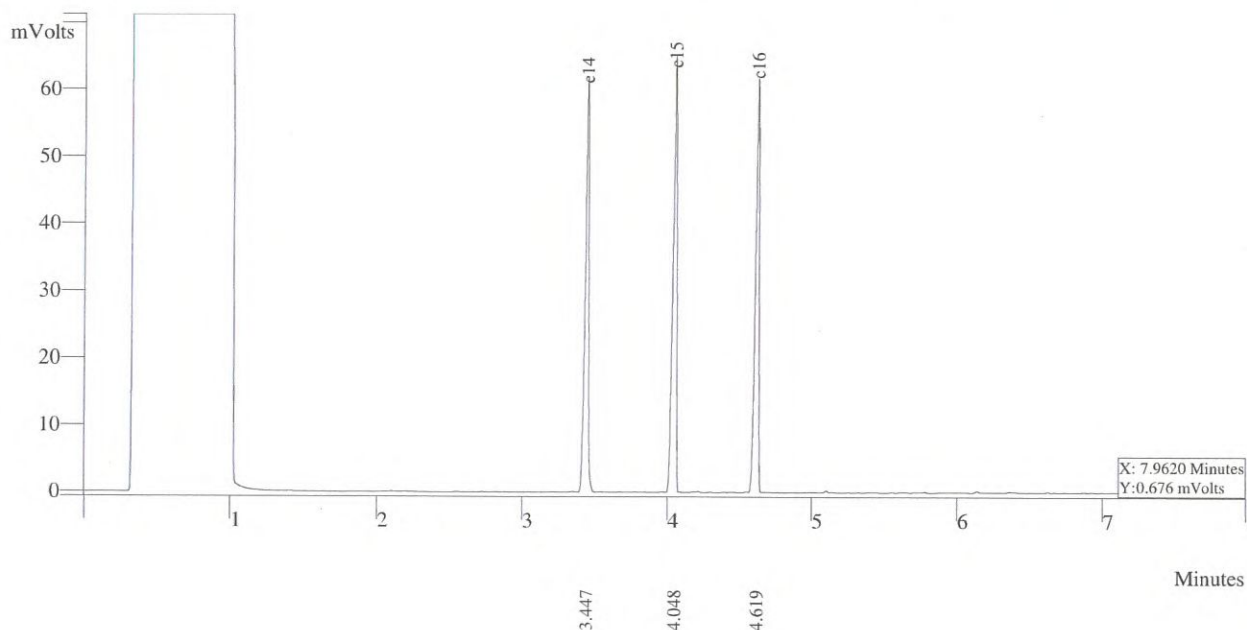
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022002.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.477	112755	VP	1.7
2	c15	33.6834	4.048	119182	VV	1.5
3	c16	34.0178	4.619	118265	VP	1.5
Totals		100.0000		348205		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): suwarot

Injection Date: 16/08/2022

Calc Date: 16/08/2022

Run Time (min): 7.993

Workstation:

Instrument (Inj): Varian Star #1



VARIAN

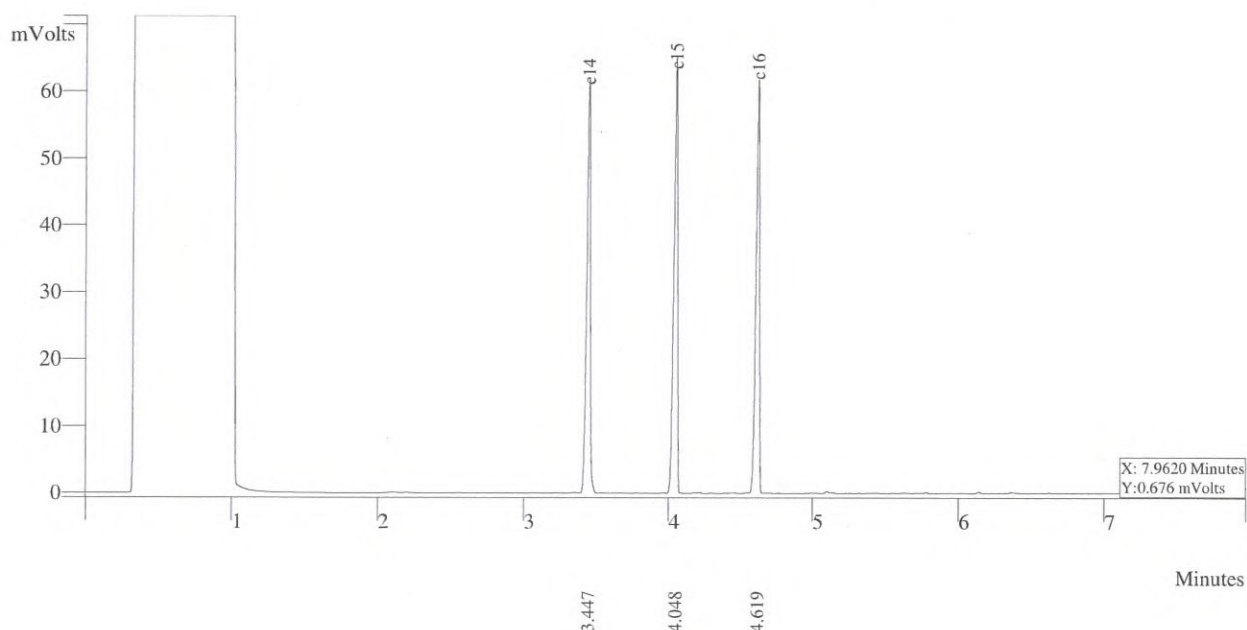
Run Mode: Analysis

Peak Measurement: Peak Area

Calculation Type: Percent

c:\star\data\tu\cal2022\fid2022003.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.477	112755	VP	1.7
2	c15	33.6834	4.048	117982	VV	1.5
3	c16	34.0178	4.619	118265	VP	1.5
Totals		100.0000		348205		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): suwarot

Injection Date: 16/08/2022

Calc Date: 16/08/2022

Run Time (min): 7.993

Workstation:

Instrument (Inj): Varian Star #1



VARIAN

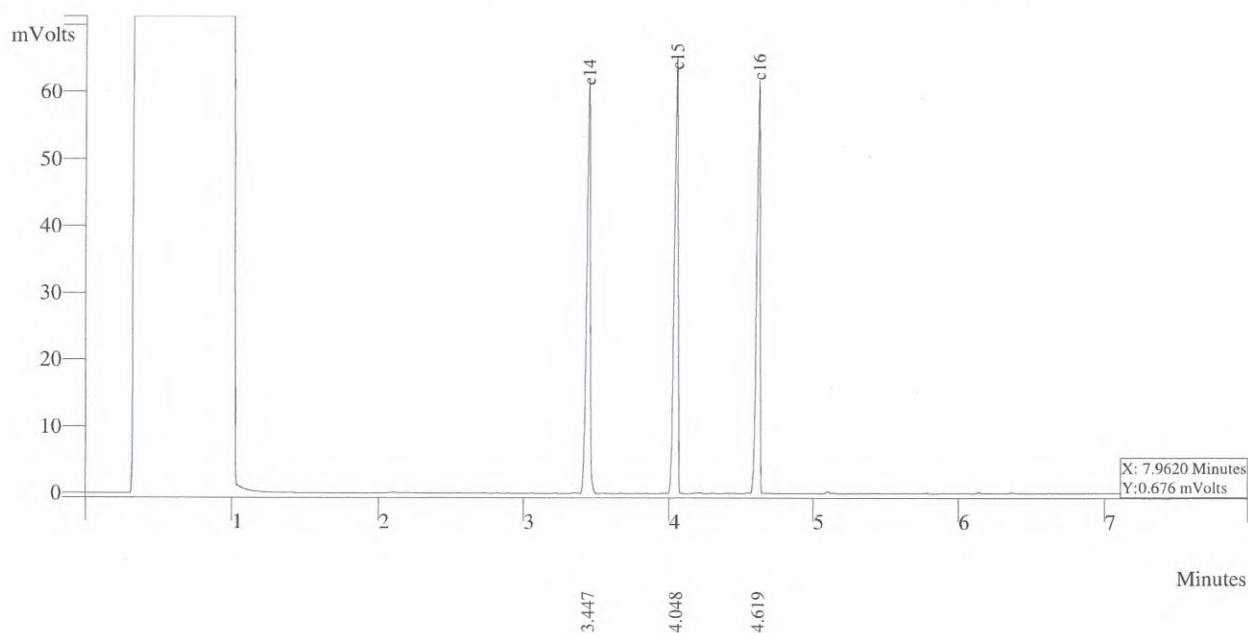
Run Mode: Analysis

Peak Measurement: Peak Area

Calculation Type: Percent

c:\star\data\tu\cal2022\fid2022004.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.377	113755	VP	1.7
2	c15	33.6834	4.048	118589	VV	1.5
3	c16	34.3178	4.619	128265	VP	1.5
Totals		100.0000		360202		



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

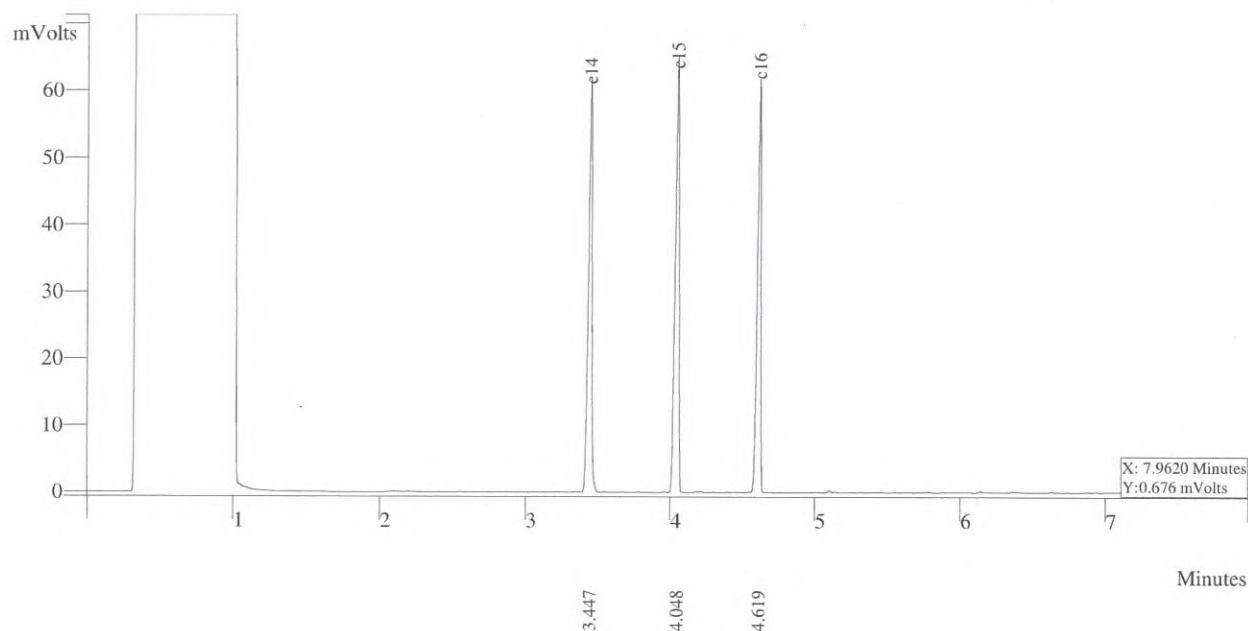
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022005.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	c14	32.2988	3.377	115755	VP	1.7
2	c15	33.6834	4.048	117592	VV	1.5
3	c16	34.3178	4.619	138265	VP	1.5
Totals		100.0000		369202		



THAI UNIQUE CO.,LTD.

1 Of 1

**QUALITY CALIBRATION CO.,LTD.**

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

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

www.qcalibration.com

CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : _____

CALIBRATION DATE : 11-Mar-22

APPROVED BY : _____

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

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

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

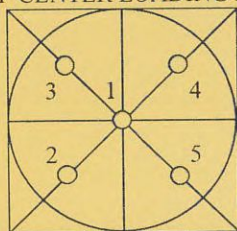
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

6. OFF CENTER LOADING ERROR



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

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

END OF CALIBRATION REPORT



Certificate of Calibration

Aquion : Anion (ID#894)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

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

ARCHEMICA LAB
บริษัท อาร์เคมีกา แล็บ จำกัด
ARCHEMICA LAB CO., LTD.

Test Engineer



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>January 12, 2022</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>July 12, 2022</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>July 14, 2021</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>2 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

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



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED January 12, 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 : 077C7042401		DATE TESTED : January 12, 2022		
PARAMETER	SPECIFICATION			FINAL VALUE
Spectral Resolution : UV	As 193.696 nm	≤ 0.007		0.00554
	Ni 231.604 nm	≤ 0.008		0.00725
	Ni 341.476 nm	≤ 0.012		0.00752
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020		0.01616
	Ba 455.403 nm	≤ 0.025		0.02416
Precision				
	As 193.656 nm	% RSD < 1.0		0.34 %
	Zn 213.856 nm	% RSD < 1.0		0.27 %
	Mn 257.610 nm	% RSD < 1.0		0.41 %
	La 379.478 nm	% RSD < 1.0		0.57 %
	Ba 455.403 nm	% RSD < 1.0		0.33 %
	Ba 493.408 nm	% RSD < 1.0		0.26 %
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)		21.00 ppb
	Zn 213.856 nm	3(sd)		0.32 ppb
	Mn 257.610 nm	3(sd)		0.18 ppb
	La 379.478 nm	3(sd)		0.44 ppb
	Ba 455.403 nm	3(sd)		0.17 ppb
	Ba 493.408 nm	3(sd)		0.12 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 077C7042401**DATE TESTED** January 12, 2022**Remarks :**

Commissioning follow as commissioning performance sheets.

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

☒

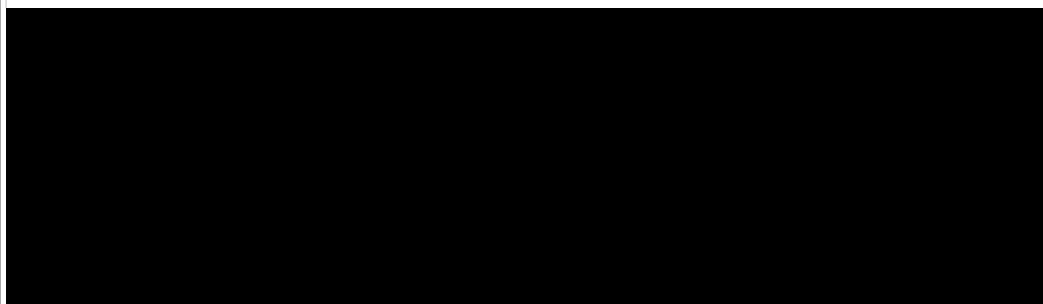
meets

☐

does not meet

the PerkinElmer Specifications listed on this certificate.

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





MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

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

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



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

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

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



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401

DATE TESTED July 11, 2022

Remarks :

Commissioning follow as commissioning performance sheets.

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

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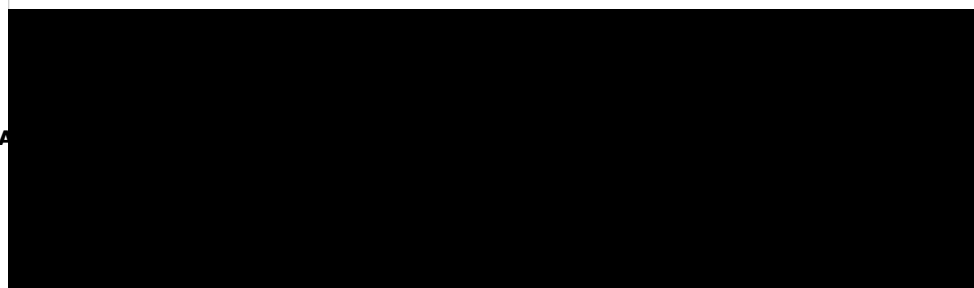
meets

☐

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.



เอกสารแนบ 5-6

เอกสารสอบเทียบเครื่องมือการตรวจวัดระดับเสียงในสถานประกอบการ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

CALIBRATION CERTIFICATE

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

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

Ambient Environment

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

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

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

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

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

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

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

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

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

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

Date of Receipt : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

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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 μ Pa at 1000 Hz

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

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

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

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Request No. 21-65/0760

MTC No. EEL. BP. 24/0965

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 : SVANTEK

Model : SV34

Serial No. : 33139

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 Panasonic VP-7722A S/N 041477D122.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2633526.

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 : 13 Sep. 2022

Date of Calibration : 19 Sep. 2022

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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Request No. 21-65/0760

MTC No. EEL. BP. 24/0965

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 = 114 dB re 20 μ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	113.63	-0.37	± 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	1000.0	0.0	± 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	0.24	± 0.50	± 4.0 %

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

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

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Noise R_629/22

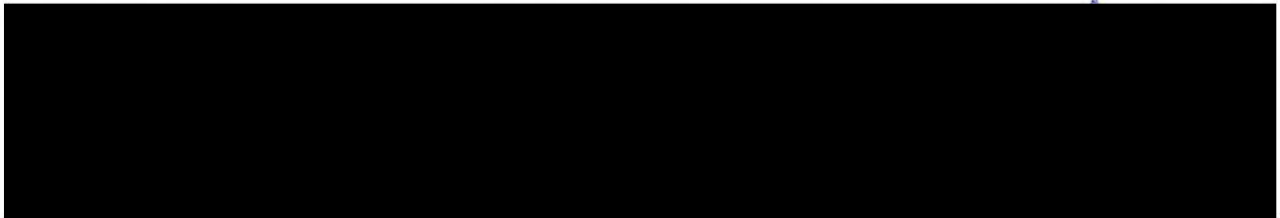
Sound Level Meter Calibration Report

Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B29	ACO	6236	00182011	20 November 2022	94.1	94.0
ACO-B36	ACO	6236	00192027	20 November 2022	94.0	94.0
ACO-B41	ACO	6236	00192032	20 November 2022	94.0	94.0
ACO-B43	ACO	6236	00192034	20 November 2022	94.1	94.0
NL 21-B01	RION	NL-21	00554245	20 November 2022	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.93 ± 0.10 dB	





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_629-1/22

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

Brand	SVANTEK	Number	SV 06/62
Model	SV34	Serial No.	33139
Calibration Range	114 dB, 1000 Hz	Last Calibration	19 September 2022
		Due Date	19 September 2023

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
NMD-B01	SVANTEK	SV-104IS	80840	20 November 2022	113.5	113.6
NMD-B02	SVANTEK	SV-104IS	80842	20 November 2022	113.6	113.6
NMD-R22	SVANTEK	SV-104IS	80801	20 November 2022	113.6	113.6
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					113.63± 0.10 dB	

เอกสารแนบ 5-7

เอกสารสอบเทียบเครื่องมือการตรวจวัดปริมาณเสียงสะสมติดตัวพนักงาน

Request No. 21-65/0760

MTC No. EEL. BP. 24/0965

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 : SVANTEK

Model : SV34

Serial No. : 33139

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 Panasonic VP-7722A S/N 041477D122.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2633526.

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 : 13 Sep. 2022

Date of Calibration : 19 Sep. 2022

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Request No. 21-65/0760

MTC No. EEL. BP. 24/0965

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 = 114 dB re 20 μ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	113.63	-0.37	± 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	1000.0	0.0	± 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	0.24	± 0.50	± 4.0 %

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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0415

MTC No. EEL. BP. 140/0365

CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 60152

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 28 Mar. 2022

Date of Calibration : 31 Mar. 2022

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the government.

FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0415

MTC No. EEL. BP. 140/0365

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
	A-weighting (dB)	C-weighting (dB)		
125	-0.3	-0.6	0.25	2.0
1 000	-0.4	0.0	0.25	1.4
4 000	-1.5	0.1	0.25	3.6

- Note :**
- 1) There was no adjustment.
 - 2) The calibration was performed at a sound pressure level of 114 dB.
 - 3) The measured values did not include the correction of microphone of UUT.
 - 4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Date of Calibration : 31 Mar. 2022

Date of Issue : 4 Apr. 2022

2 / 2

End of Certificate

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

FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0415

MTC No. EEL. BP. 142/0365

CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svanitek

Model : SV-104IS

Serial No. : 60155

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 28 Mar. 2022

Date of Calibration : 31 Mar. 2022

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the government.

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FM.BL.MTC.002 Rev.4

Request No. 21-65/0415

MTC No. EEL. BP. 142/0365

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.9	0.9	0.25	2.0
1 000	0.2	0.4	0.25	1.4
4 000	0.0	0.0	0.25	3.6

- Note :**
- 1) There was no adjustment.
 - 2) The calibration was performed at a sound pressure level of 114 dB.
 - 3) The measured values did not include the correction of microphone of UUT.
 - 4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Date of Calibration : 31 Mar. 2022

Date of Issue : 4 Apr. 2022

2 / 2

End of Certificate

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.

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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

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Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

Request No. 21-65/0415

MTC No. EEL. BP. 143/0365

CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 60146

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 28 Mar. 2022

Date of Calibration : 31 Mar. 2022

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

Request No. 21-65/0415

MTC No. EEL. BP. 143/0365

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.1	0.3	0.25	2.0
1 000	-0.2	0.0	0.25	1.4
4 000	-1.1	-0.4	0.25	3.6

- Note :**
- 1) There was no adjustment.
 - 2) The calibration was performed at a sound pressure level of 114 dB.
 - 3) The measured values did not include the correction of microphone of UUT.
 - 4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Date of Calibration : 31 Mar. 2022

Date of Issue : 4 Apr. 2022

2 / 2

End of Certificate

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

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FM.BL.MTC.002 Rev.4

Head Office
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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Fax. (66) 0 2323 9165
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0415

MTC No. EEL. BP. 144/0365

CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 63438

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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Date of Receipt : 28 Mar. 2022

Date of Calibration : 31 Mar. 2022

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FM.BL.MTC.002 Rev.4

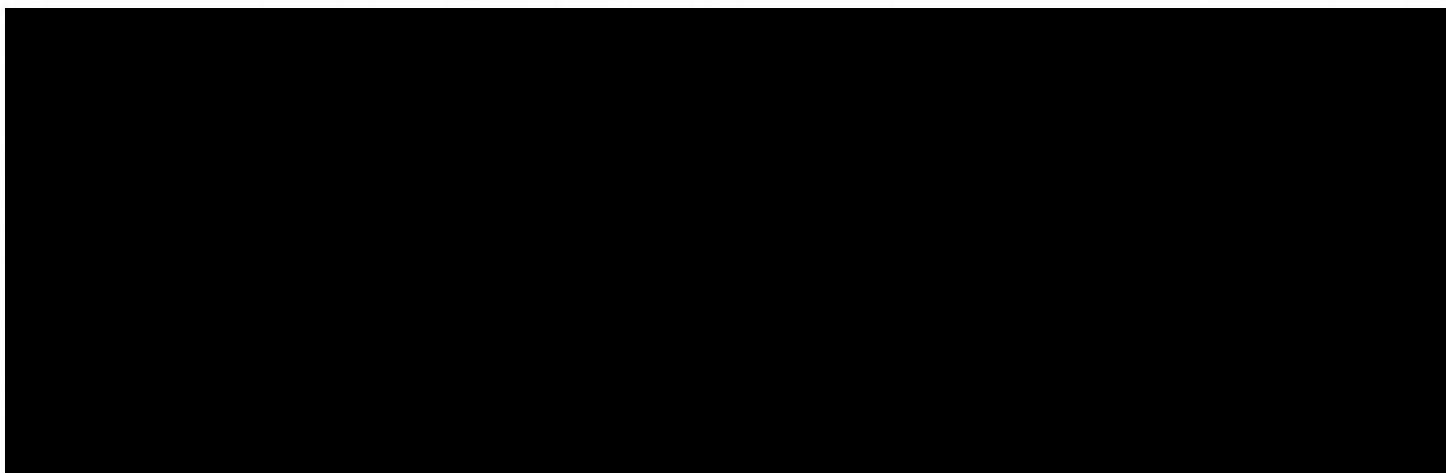
Request No. 21-65/0415

MTC No. EEL. BP. 144/0365

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	-0.1	0.0	0.25	2.0
1 000	-0.3	0.0	0.25	1.4
4 000	-0.5	-0.3	0.25	3.6

- Note :**
- 1) There was no adjustment.
 - 2) The calibration was performed at a sound pressure level of 114 dB.
 - 3) The measured values did not include the correction of microphone of UUT.
 - 4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).



Date of Calibration : 31 Mar. 2022

Date of Issue : 4 Apr. 2022

2 / 2

End of Certificate

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0415

MTC No. EEL. BP. 145/0365

CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 70035

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 28 Mar. 2022

Date of Calibration : 4 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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E-mail : sumalee@tistr.or.th

Request No. 21-65/0415

MTC No. EEL. BP. 145/0365

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	-0.1	-0.1	0.25	2.0
1 000	0.1	0.0	0.25	1.4
4 000	0.7	0.7	0.25	3.6

- Note :**
- 1) There was no adjustment.
 - 2) The calibration was performed at a sound pressure level of 114 dB.
 - 3) The measured values did not include the correction of microphone of UUT.
 - 4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).



Date of Calibration : 4 Apr. 2022

Date of Issue : 5 Apr. 2022

2 / 2

End of Certificate

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

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0415

MTC No. EEL. BP. 148/0365

CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 80837

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 28 Mar. 2022

Date of Calibration : 4 Apr. 2022

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E-mail : sumalee@tistr.or.th

Request No. 21-65/0415

MTC No. EEL. BP. 148/0365

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.0	-0.1	0.25	2.0
1 000	0.1	0.0	0.25	1.4
4 000	0.4	0.5	0.25	3.6

- Note :**
- 1) There was no adjustment.
 - 2) The calibration was performed at a sound pressure level of 114 dB.
 - 3) The measured values did not include the correction of microphone of UUT.
 - 4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Date of Calibration : 4 Apr. 2022

Date of Issue : 5 Apr. 2022

2 / 2

End of Certificate

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FM.BL.MTC.002 Rev.4

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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 Dose R_606/22

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

Brand	SVANTEK	Number	SV 06/62
Model	SV34	Serial No.	33139
Calibration Range	114 dB, 1000 Hz	Last Calibration	19 September 2022
		Due Date	19 September 2023

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
NMD-B03	SVANTEK	SV-104IS	80852	20 November 2022	113.6	113.6
NMD-B04	SVANTEK	SV-104IS	80854	20 November 2022	113.5	113.6
NMD-R02	SVANTEK	SV-104IS	60152	20 November 2022	113.6	113.6
NMD-R03	SVANTEK	SV-104IS	60153	20 November 2022	113.5	113.6
NMD-R05	SVANTEK	SV-104IS	60155	20 November 2022	113.6	113.6
NMD-R06	SVANTEK	SV-104IS	60146	20 November 2022	113.6	113.6
NMD-R13	SVANTEK	SV-104IS	63438	20 November 2022	113.5	113.6
NMD-R20	SVANTEK	SV-104IS	70035	20 November 2022	113.6	113.6
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					113.63± 0.10 dB	



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

Noise Dose R_698/22

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

Brand	SVANTEK	Number	SV 06/62
Model	SV34	Serial No.	33139
Calibration Range	114 dB, 1000 Hz	Last Calibration	19 September 2022
		Due Date	19 September 2023

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
NMD-R05	SVANTEK	SV-104IS	60155	14 December 2022	113.5	113.6
NMD-R13	SVANTEK	SV-104IS	63438	14 December 2022	113.6	113.6
NMD-R27	SVANTEK	SV-104IS	80837	14 December 2022	113.6	113.6
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					113.63± 0.10 dB	

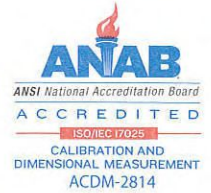
เอกสารแนบ 5-8

เอกสารสอบเทียบเครื่องมือการตรวจวัดแสงสว่างในสถานประกอบการ



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



CERTIFICATE OF CALIBRATION FOR

NOMENCLATURE : LUX METER
MANUFACTURER : EXTECH INSTRUMENTS
MODEL / TYPE : 407026
SERIAL NO. : A.052323/A.052323 [LUX-R07]
CLID. NO. : 252201553
JOB CONTROL NO. : 220704067252

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

DATE OF RECEIVED : 04 July 2022

DATE OF ISSUED : 18 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 :



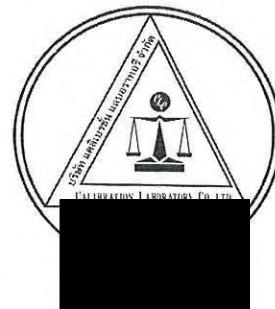
Calibration Engineer



Approved By :

Authorized Signatory

18 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. Q22067252

F3-011-04/01-12

page 1 of 3

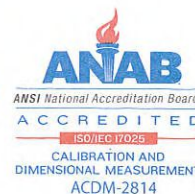


@clccalibration



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



REPORT OF CALIBRATION

FOR

NOMENCLATURE : LUX METER
MANUFACTURER : EXTECH INSTRUMENTS
MODEL / TYPE : 407026
SERIAL NO. : A.052323/A.052323 [LUX-R07]
DATE OF CALIBRATION : 12 July 2022

ENVIRONMENT CONDITIONS :

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

Relative Humidity : $(55 \pm 15) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPEE-18** by comparison with Illuminance Sensor which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Illuminance Sensor, Bentham Model ORM400/DH400VL S/N. 27710/1/27585/3.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Optical Test and Calibration Ltd.
Certificate No. 131916/ABU/1. Due Date 25 February 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22067252

F3-011-04/01-12

page 2 of 3



@clccalibration

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

CALIBRATION DATA

LUX METER RESULT

STD Applied (lux)	DUC Reading (lux)	Correction (lux)	Uncertainty \pm (% of rdg.)
100	103	-3	3.5
200	206	-6	3.8
300	309	-9	4.7
1000	1028	-28	4.7
2000	2020	-20	4.9
3000	3040	-40	5.6

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 46 of 54

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

End of Certificate

Certificate No. Q22067252

F3-011-04/01-12

page 3 of 3



เอกสารแนบ 5-9

เอกสารสอบเทียบเครื่องมือการตรวจวัดระดับความร้อนในสถานประกอบการ



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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



NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSI010011

CLID. NO. : 232000797

JOB CONTROL NO. : 220815082000

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

DATE OF RECEIVED : 15 August 2022

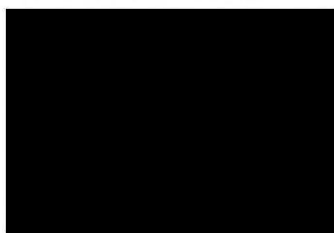
DATE OF ISSUED : 20 August 2022

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

Calibrated By :



Calibration Engineer



Approved By :

Authorized Signatory

20 August 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. Q22082000

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NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSI010011

DATE OF CALIBRATION : 18 August 2022

ENVIRONMENT CONDITIONS :

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

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

PROCEDURE USED :

This instrument was calibrated under procedure No. **WI-305-74**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation.

Certificate No. 19944, Due Date 26 January 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22082000

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CALIBRATION LABORATORY Co., LTD.

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

*1. CORRECTION OF TEMPERATURE [WET]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	31.0	-1.02	0.40
35.0	34.98	36.2	-1.22	
40.0	40.00	41.3	-1.30	

Note. * means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

2. CORRECTION OF TEMPERATURE [DRY]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.0	-0.02	0.40
35.0	34.98	34.9	+0.08	
40.0	40.00	40.1	-0.10	

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.0	-0.02	0.40
35.0	34.98	34.9	+0.08	
40.0	40.00	39.7	+0.30	

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q22082000

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page 3 of 3



@clccalibration



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CALIBRATION LABORATORY Co., LTD.

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSH120011

CLID. NO. : 232000795

JOB CONTROL NO. : 220505044292

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

DATE OF RECEIVED : 05 May 2022

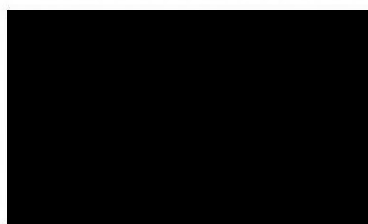
DATE OF ISSUED : 12 May 2022

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

Calibrated By :



Calibration Engineer



Approved By :

Authorized Signatory

12 May 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. Q22044292

F3-011-04/01-12

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@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : **DIGITAL THERMOHYGRO METER**
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : **3M**

MODEL / TYPE : **QUESTemp° 46**

SERIAL NO. : **TSH120011**

DATE OF CALIBRATION : **05 May 2022**

ENVIRONMENT CONDITIONS :

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

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

PROCEDURE USED :

This instrument was calibrated under procedure No. **WI-305-74**. The calibration was performed by using
Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 36151.
Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.
Certificate No. 19317, Due Date 09 July 2022.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied
by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. **Q22044292**

F3-011-04/01-12

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

*1. CORRECTION OF TEMPERATURE [WET]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.99	31.4	-1.41	0.40
35.0	35.01	36.4	-1.39	
40.0	39.99	41.4	-1.41	

Note. * means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

2. CORRECTION OF TEMPERATURE [DRY]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.99	30.0	-0.01	0.40
35.0	35.01	35.1	-0.09	
40.0	39.99	40.2	-0.21	

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.99	29.9	+0.09	0.40
35.0	35.01	34.8	+0.21	
40.0	39.99	39.6	+0.39	

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q22044292

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@clccalibration

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSI010006

CLID. NO. : 232000793

JOB CONTROL NO. : 220505044316

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

DATE OF RECEIVED : 05 May 2022

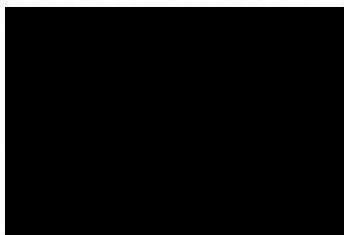
DATE OF ISSUED : 12 May 2022

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

Calibrated By :



Calibration Engineer



Approved By :

Authorized Signatory

12 May 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. Q22044316

F3-011-04/01-12

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : **DIGITAL THERMOHYGRO METER**
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : **3M**

MODEL / TYPE : **QUESTemp° 46**

SERIAL NO. : **TSI010006**

DATE OF CALIBRATION : **05 May 2022**

ENVIRONMENT CONDITIONS :

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

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

PROCEDURE USED :

This instrument was calibrated under procedure No. **WI-305-74**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 36151.
Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.
Certificate No. 19317, Due Date 09 July 2022.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. **Q22044316**

F3-011-04/01-12

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NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

*1. CORRECTION OF TEMPERATURE [WET]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.99	31.5	-1.51	0.40
35.0	35.01	36.5	-1.49	
40.0	39.99	41.5	-1.51	

Note. * means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

2. CORRECTION OF TEMPERATURE [DRY]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.99	30.1	-0.11	0.40
35.0	35.01	35.0	+0.01	
40.0	39.99	40.1	-0.11	

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.99	30.1	-0.11	0.40
35.0	35.01	35.0	+0.01	
40.0	39.99	39.6	+0.39	

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q22044316

F3-011-04/01-12

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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



NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSH120025

CLID. NO. : 232000794

JOB CONTROL NO. : 220815082001

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

DATE OF RECEIVED : 15 August 2022

DATE OF ISSUED : 20 August 2022

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

Calibrated By :



Calibration Engineer



Approved By :

Authorized Signatory

20 August 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. Q22082001

F3-011-04/01-12

page 1 of 3



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REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSH120025

DATE OF CALIBRATION : 18 August 2022

ENVIRONMENT CONDITIONS :

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

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

PROCEDURE USED :

This instrument was calibrated under procedure No. **WI-305-74**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.

Certificate No. 19944, Due Date 26 January 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22082001

F3-011-04/01-12

page 2 of 3





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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025
CALIBRATION 0059
CLC

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

*1. CORRECTION OF TEMPERATURE [WET]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	31.1	-1.12	0.40
35.0	34.98	36.2	-1.22	
40.0	40.00	41.2	-1.20	

Note. * means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

2. CORRECTION OF TEMPERATURE [DRY]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.1	-0.12	0.40
35.0	34.98	34.9	+0.08	
40.0	40.00	39.9	+0.10	

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.1	-0.12	0.40
35.0	34.98	34.8	+0.18	
40.0	40.00	39.9	+0.10	

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q22082001

F3-011-04/01-12

page 3 of 3



@clccalibration



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

Heat B173_1/22

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: R13	Verification Date	: 20 November 2022
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp ^o 46	Barometric Pressure	: 1011 mmbar
Serial No.	: TSIO10011	Relative Humidity	: 49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.3	0.2	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.0	0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			



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

Heat B173_2/22

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: R14	Verification Date	: 20 November 2022
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp ^o 46	Barometric Pressure	: 1011 mmbar
Serial No.	: TSH120011	Relative Humidity	: 49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.7	-0.2	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.0	0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.1	0.2	± 0.5
UUC* = UNIT UNDER CALIBRATION			



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร 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

Heat B173_3/22

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: R15	Verification Date	: 20 November 2022
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp ^o 46	Barometric Pressure	: 1011 mmbar
Serial No.	: TSIO10006	Relative Humidity	: 49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.5	0.0	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			



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Heat B173_4/22

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: R16	Verification Date	: 20 November 2022
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp ^o 46	Barometric Pressure	: 1011 mmbar
Serial No.	: TSH120025	Relative Humidity	: 49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.4	0.1	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.0	0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.1	0.2	± 0.5
UUC* = UNIT UNDER CALIBRATION			