

ภาคผนวก ง

เอกสารการสอบเทียบ  
เครื่องมือตรวจวัดและวิเคราะห์

## High Volume Sampler Calibration

### CONDITIONS

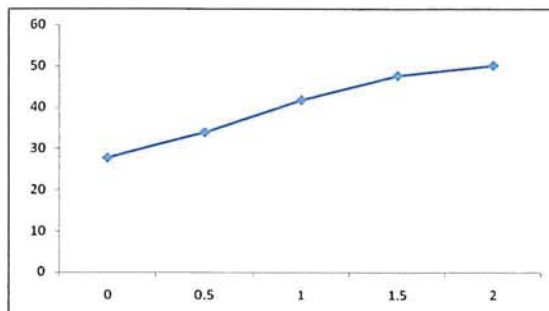
Barometric Pressure (mm Hg)	:	752.80	Corrected Pressure (mm Hg)	:	753
Temperature rapture (deg C)	:	32	Temperature	:	305
Average Press. (mm Hg)	:	752.80	Corrected Average (mm Hg)	:	753
Average Temp. (deg C)	:	31	Average Temp. (deg K)	:	304

### CALIBRATION ORIFICE

Make	:	General Metal Works	Qstd Slope	:	1.89677
Model	:	GMW	Qstd Intercept	:	-0.02329
Serial #	:	F36	Date Certified	:	January 18, 2022

### CALIBRATIONS

Plate or	H2O	Qstd	I	IC	LINEAR	
Test #	(in)	(m3/min)	(Chart)	(Corrected)	REGRESSION	
15	9.20	1.587	52.5	51.69	Slope	= 30.0359
13	7.60	1.443	48.5	47.75	Intercept	= 4.4591
10	5.22	1.198	42.5	41.84	Corr. Coeff.	= 0.9976
7	3.42	0.972	34.0	33.48		
5	2.20	0.782	28.5	28.06	# of Observations	: 5
Range of Chart						37
at 1.1-1.7 m3/min						56



Calibrated By :



Mr. PASAGORN SAMOL



## บริษัท เอ็นไวร์ เซอร์วิส จำกัด

บริษัท เอ็นไวร์ เซอร์วิส จำกัด  
ENVIR SERVICE CO., LTD.

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201  
42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201

### Analyzer Performance Test

Calibrated Date: 18 January 2022

#### Instruments Information

Analyzer Type: CO Analyzer Model: 300	Manufacturer API S/N: 1306
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#### Calibration System

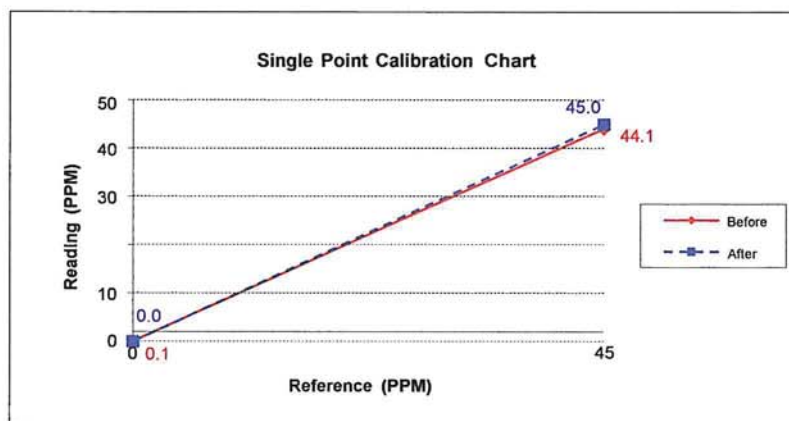
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 45.2 PPM SO2 Conc 44.9 PPM CO Conc 4,490 PPM Expire Date: 6 October 2022

Environment: Temperature 25.5 °C

Humidity: 51 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.1	0.1	45.0	44.1	-2.0
After	0.0	0.0	0.0	45.0	45.0	0.0



Calibrate By :

## Analyzer Performance Test

Calibrated Date: 18 January 2022

### Instruments Information

Analyzer Type: CO Analyzer Model: 300	Manufacturer API S/N: 1371
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### Calibration System

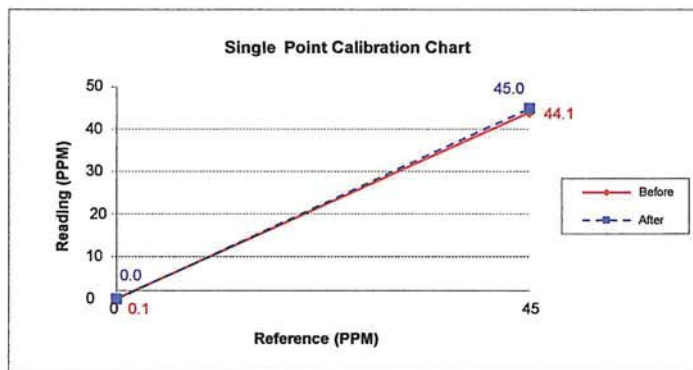
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 45.2 PPM SO2 Conc 44.9 PPM CO Conc 4,490 PPM Expire Date: 6 October 2022

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### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.1	0.1	45.0	44.1	-2.0
After	0.0	0.0	0.0	45.0	45.0	0.0



Calibrate By:



Mr. PASAGORN SAMOL





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42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201

### Analyzer Performance Test

Calibrated Date: 18 January 2022

#### Instruments Information

Analyzer Type: CO Analyzer Model: 48C	Manufacturer Thermo Environmental S/N: 48C-65775-350
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#### Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 45.2 PPM SO <sub>2</sub> Conc 44.9 PPM CO Conc 4,490 PPM Expire Date: 6 October 2022

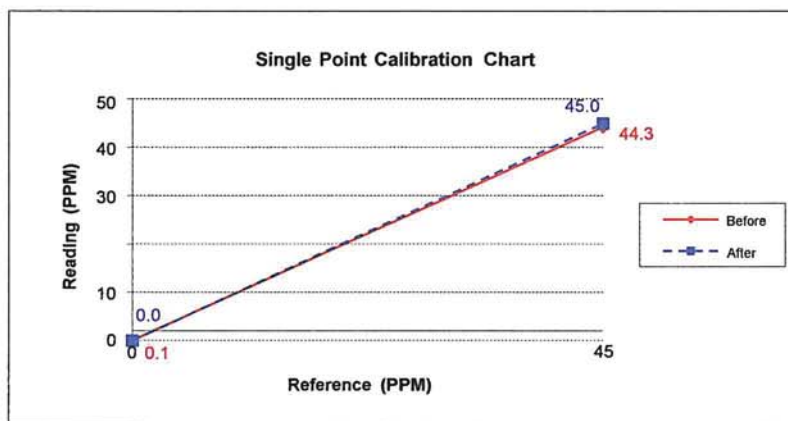
Environment: Temperature 25.5 °C

Humidity: 51 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.1	0.1	45.0	44.3	-1.6
After	0.0	0.0	0.0	45.0	45.0	0.0

20



Calibrate By :

Mr. PASAGORN SAMOL



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42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201

### Analyzer Performance Test

Calibrated Date: 18 January 2022

#### Instruments Information

Analyzer Type: CO Analyzer Model: 300	Manufacturer API S/N: 1307
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#### Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 45.2 PPM SO2 Conc 44.9 PPM CO Conc 4,490 PPM Expire Date: 6 October 2022

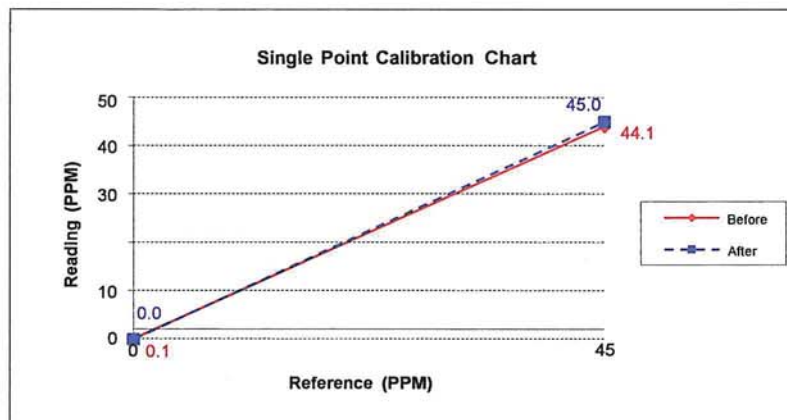
Environment: Temperature 25.5 °C

Humidity: 51 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.1	0.1	45.0	44.1	-2.0
After	0.0	0.0	0.0	45.0	45.0	0.0

20



Calibrate By :

*[Signature]*

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0279

MTC No. EEL. BP. 120/0165

CALIBRATION CERTIFICATE

Submitted by : SAFETY PLAN CO., LTD.

Address : 1034 Moo 3 Rangsit-pathumthani Rd., Tambol Bangpoon, Amphur Maung Pathumthani 12000.

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 Level Calibrator

Manufacturer : Rion

Model : NC-73

Serial No. : 10848247

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 : 28 Jan. 2022

Date of Calibration : 8 Feb. 2022

1 / 2

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

Head Office

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Fax. (66) 0 2323 9165

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Thailand

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Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0279

MTC No. EEL. BP. 120/0165

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	94.26	0.26	$\pm 0.10$	$\pm 0.75$ 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	998.7	-1.3	$\pm 1.5$	$\pm 2.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1.95	$\pm 0.50$	$\pm 4.0\%$

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

Calibrated by :



(Mr.Tawikiat Iamsamran)

Approved by :

  
(Mr.Prawate Kluiyapa)  
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 8 Feb. 2022

Date of Issue : 9 Feb. 2022

Ref : 2011265012800389002

2 / 2

End of Certificate

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Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th



Safety Plan Co., Ltd.

บริษัท เซฟตี้ แพลน จำกัด

1034 หมู่ 3 ถนนรังสิต-ปทุมธานี ตำบลบางพลี อำเภอมัญจาคีรี จังหวัดปทุมธานี 12000 โทรศัพท์ 0-2567-3549 โทรสาร 0-2567-3485  
1034 Moo 3 Rangsit-Pathum Thani Rd., Tambol Bangpooon, Amphur Muang, Pathum Thani 12000 Tel. 0-2567-3549 Fax 0-2567-3485

## Calibration Sound Level Meter Certificate

Date of Calibration : February 9, 2022

### Condition of Calibration

Temperature : (° c)  $25 \pm 2$  Humidity : (%RH)  $50 \pm 10$

Ambient Pressure : 758.8 mmHg

### Signal Level Adjustment

Level Range : 60-120 dB Time Weighting : Slow

Frequency Weighting : C Acoustic Calibrator : 114.0 dB

### Reference Equipment

Sound Level Calibrator Quest Technologies

Model : NC-73 Serial No. : 10848247

Reference No. : MTC No. EEL.BP. 38/0264 (TISTR)

Calibration Date : February 8, 2022

Integrating Sound Level Meter : ACO TYPE 6226

Intergrating Sound Level Meter	Reading (dB)	Error (dB)	Adjustment
SLM (S1) ACO S/N 140075	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S2) ACO S/N 120077	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S3) ACO S/N 140072	113.9	0.1	Adjusted +0.1 to 114.0
SLM (S4) ACO S/N 120078	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S5) ACO S/N 140073	113.9	-0.2	Adjusted +0.1 to 114.0
SLM (S6) ACO S/N 120080	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S7) ACO S/N 140074	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S8) ACO S/N 120079	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S9) ACO S/N 060176	113.9	0.1	Adjusted +0.1 to 114.0
SLM (S10) ACO S/N 060177	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S11) ACO S/N 090053	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S12) ACO S/N 75938	113.9	0.1	Adjusted +0.1 to 114.0
SLM (S13) ACO S/N 75936	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (S14) ACO S/N 75937	113.9	-0.2	Adjusted +0.1 to 114.0

Calibrated By :

ชวาลิต ่อนไสว

(Mr. Chawwalit Onswai)

Approve By :



(Mr. Narongsak Serpanitkarn)



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0279

MTC No. EEL. BP. 120/0165

CALIBRATION CERTIFICATE

Submitted by : SAFETY PLAN CO., LTD.

Address : 1034 Moo 3 Rangsit-pathumthani Rd., Tambol Bangpoo, Amphur Maung Pathumthani 12000.

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 Level Calibrator

Manufacturer : Rion

Model : NC-73

Serial No. : 10848247

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.

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

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Date of Calibration : 8 Feb. 2022

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Request No. 21-65/0279

MTC No. EEL. BP. 120/0165

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

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

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

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Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
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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	998.7	-1.3	$\pm 1.5$	$\pm 2.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1.95	$\pm 0.50$	$\pm 4.0\%$


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

Calibrated by :



(Mr.Tawikiat Iamsamran)

Approved by :

  
(Mr.Prawate Khlaypa)  
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 8 Feb. 2022

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Ref : 2011265012800389002

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1034 Moo 3 Rangsit-Pathum Thani Rd., Tambol Bangkuan, Amphur Muang, Pathum Thani 12000 Tel. 0-2567-3549 Fax 0-2567-3485

## Calibration Sound Level Meter Certificate

Date of Calibration : February 9, 2022

### Condition of Calibration

Temperature : ( $^{\circ}\text{C}$ )  $25 \pm 2$  Humidity : (%RH)  $50 \pm 10$   
Ambient Pressure : 758.8 mmHg

### Signal Level Adjustment

Level Range : 60-120 dB Time Weighting : Slow  
Frequency Weighting : C Acoustic Calibrator : 114.0 dB

### Reference Equipment

Sound Level Calibrator Quest Technologies

Model : NC-73 Serial No. : 10848247  
Reference No. : MTC No. EEL.BP. 38/0264 (TISTR)  
Calibration Date : February 8, 2022  
Integrating Sound Level Meter : PICCOLO

Integrating Sound Level Meter	Reading (dB)	Error (dB)	Adjustment
SLM (No.1) PICCOLO S/N P0220012705	113.9	0.1	Adjusted +0.1 to 114.0
SLM (No.2) PICCOLO S/N P0220012801	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (No.3) PICCOLO S/N P0220031802	113.9	0.1	Adjusted +0.1 to 114.0
SLM (No.4) PICCOLO S/N P0220031804	113.9	-0.2	Adjusted +0.1 to 114.0
SLM (No.5) PICCOLO S/N P0220031803	113.9	0.1	Adjusted +0.1 to 114.0
SLM (No.6) PICCOLO S/N P0220012704	113.9	-0.2	Adjusted +0.1 to 114.0
SLM (No.7) PICCOLO S/N P0220012703	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (No.8) PICCOLO S/N P0220031801	113.9	0.1	Adjusted +0.1 to 114.0
SLM (No.9) PICCOLO S/N P0220012802	113.9	-0.1	Adjusted +0.1 to 114.0
SLM (No.10) PICCOLO S/N P0220031901	113.9	-0.1	Adjusted +0.1 to 114.0

Calibrated By : ชาวลิต ่อนสว  
(Mr. Chawwalit Onswai)

Approve By : หรรษ  
(Mr. Narongsak Seripantkarn)





## Calibration Certificate

Part Number: 716A0403  
Description: MINIMATE PLUS W/EXT. GEO

Serial Number: BE21376  
Calibration Date: **Dec 01 2021**  
Calibration Equipment: 718A1501-02

*Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.*

*Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.*

*The environment in which this product was calibrated is maintained within the operating specifications of the instrument.*

*Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.*

Calibrated By: \_\_\_\_\_

Roberto jolo





## Calibration Certificate

Part Number: 716A0403  
Description: MINIMATE PLUS W/EXT. GEO

Serial Number: BE21376  
Calibration Date: **Dec 01 2022**  
Calibration Equipment: 718A1501-02

*Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.*

*Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.*

*The environment in which this product was calibrated is maintained within the operating specifications of the instrument.*

*Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.*

Calibrated By: \_\_\_\_\_

Roberto jolo







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Cert. No.: 20TM1759

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Hot Air Oven

**Manufacturer :** Memmert

**Model :** UFB 400

**Serial No. :** G405.0773

**ID No. :** SAF.LAB.017-2548

**Submitted by :** Safety Plan Co.,Ltd.  
1034 Moo 3, Rangsit - Pathumthani Road,  
T. Bangpoon, A. Muang,  
Pathumthani 12000

**Location :** Laboratory Room (Safety Plan Co.,Ltd.)

**Received Order :** 24 September 2020

**Calibration Date :** 24 September 2020

**Ambient Temperature :** (  $26 \pm 10$  ) °C

**Relative Humidity :** (  $50 \pm 30$  ) %

**Calibrated by :** Prawit Sodavitchit

**Approved by :**

*Malee*

Approved Signatory

- ( ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 29 September 2020

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

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2009-0629ON-3  
 Procedure Used :-

Cert. No.: 20TM1759  
 Page.: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1 ) Data Acquisition	MY41021843	20LM1	NIMT, NIST	29 Dec 2020

2. This certification is traceable to the SI unit.

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

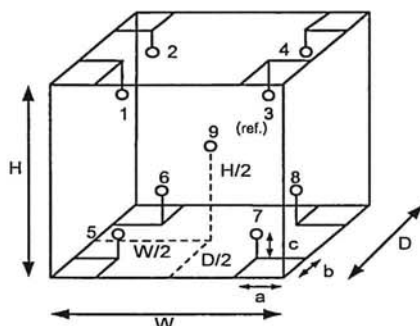
**Remark :** NIMT : National Institute of Metrology Thailand.

NIST : National Institute of Standards and Technology, The United State of America.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL.Humid. ( % )	55	58
AC Supply ( Volt )	220	220

Probe Installation Details :		Dimension of Chamber :	
a =	5.0 cm	D =	0.33 m
b =	5.0 cm	W =	0.40 m
c =	5.0 cm	H =	0.40 m
		Capacity =	0.053 m <sup>3</sup>

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

*malu.*



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2009-0629ON-3  
**Result of Calibration :-** ( \* ) Without Adjustment

**Cert. No.:** 20TM1759  
**Page.:** 3 of 3

**Function of UUC\* :** Temperature Source

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
104.0	104.0	104.0	0.071	0.73	1.2	0.43	2
180.0	180.0	180.0	0.18	1.4	2.5	1.1	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.895	104.145	103.534	103.851	104.683	104.294	104.179	103.839	104.003
180.0	179.592	179.827	179.223	179.805	179.835	181.052	178.771	180.885	180.072

**Average\* :** The average of 30 values in each position.

**Temperature stability :** One-half of the greatest maximum difference of measured temperature at any one sensor.

**Temperature uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

**Overall Variation :** The Difference of the maximum and minimum measured temperatures throughout observation.

**UUC\* :** Unit Under Calibration

**Note :** The reported uncertainty of measurement was included stability and excluded uniformity .

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

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*Male*



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Cert. No.: 20TM1840  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : KW.Pack  
Model : WNB30-SC  
Serial No. : 0366  
ID No. : SAF.LAB.014-2548  
Submitted by : Safety Plan Co.,Ltd.  
1034 Moo 3, Rangsit-Pathumthani Road,  
T.Bangpoon, A.Muang,  
Pathumthani 12000  
Location : Laboratory Room (Safety plan Co.,Ltd.)  
Received Order : 24 September 2020  
Calibration Date : 24 September 2020  
Ambient Temperature : ( 26  $\pm$  10 ) °C  
Relative Humidity : ( 50  $\pm$  30 ) %

Calibrated by : Kunchit Promprat

Approved by :

*Malee*

Approved Signatory

( ) Pornthippa Tameyakul  
(☒) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 29 September 2020

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

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Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2009-0629ON-4

Cert. No.: 20TM1840  
 Page.: 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1 ) Data Acquisition	MY44060450	20LM3	NIMT, NIST	07 Mar 2021

2. This certification is traceable to the SI unit.

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

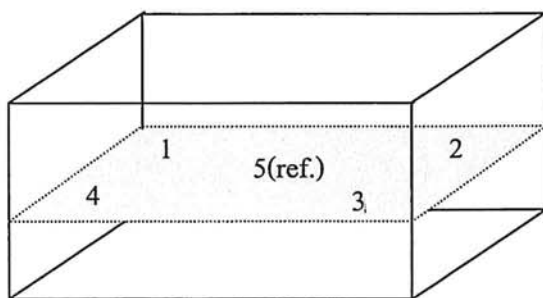
**Remark :** NIMT : National Institute of Metrology Thailand.

NIST : National Institute of Standards and Technology, The United State of America.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

	<u>Environmental</u>		<u>AC Voltage Supply</u>
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	25	62	225
Finished of Calibration	26	65	225



Front

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

*make*





Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2009-0629ON-4  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 20TM1840  
Page.: 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.895	85.089	85.171	85.049	85.147

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
85.0	0.38	0.10	0.17	2

**Average\*** : The average of 30 values in each position.

**Uniformity** : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

**Stability** : One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\*** : Unit Under Calibration

**Note** : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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Malu.



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Cert. No.: 20TM1760

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Incubator

**Manufacturer :** Biobase

**Model :** BJPX-B150II

**Serial No. :** 06091902

**ID No. :** -

**Submitted by :** Safety Plan Co.,Ltd.  
1034 Moo 3, Rangsit - Pathumthani Road,  
T. Bangpoon, A. Muang,  
Pathumthani 12000

**Location :** Laboratory Room (Safety Plan Co.,Ltd.)

**Received Order :** 24 September 2020

**Calibration Date :** 25 September 2020

**Ambient Temperature :** (  $26 \pm 10$  ) °C

**Relative Humidity :** (  $50 \pm 30$  ) %

**Calibrated by :** Prawit Sodavitchit

**Approved by :**

Approved Signatory

( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 29 September 2020

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Incubator  
 Condition As-Received : Used Item  
 Reference : 2009-0629ON-6  
 Procedure Used :-

Cert. No.: 20TM1760  
 Page.: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1 ) Data Acquisition	MY41021843	20LM1	NIMT, NIST	29 Dec 2020

2. This certification is traceable to the SI unit.

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

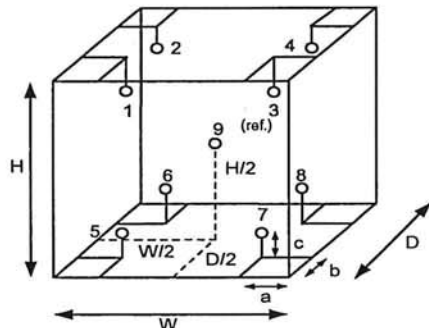
**Remark :** NIMT : National Institute of Metrology Thailand.

NIST : National Institute of Standards and Technology, The United State of America.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



Environment during calibration		
	Beginning	Finished
Temp. ( °C )	24	24
REL.Humid. ( % )	55	58
AC Supply ( Volt )	220	220

**Probe Installation Details :**

a = 5.0 cm  
 b = 5.0 cm  
 c = 5.0 cm

**Dimension of Chamber :**

D = 0.40 m  
 W = 0.45 m  
 H = 0.85 m  
 Capacity = 0.15 m<sup>3</sup>

Position :	Ref. Std./ID No.:
1	18-04RTD-01
2	18-04RTD-02
3	18-04RTD-03
4	18-04RTD-04
5	18-04RTD-05
6	18-04RTD-06
7	18-04RTD-07
8	18-04RTD-08
9 (ref.)	18-04RTD-09

*Malu.*



**Equipment :** Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2009-0629ON-6  
**Result of Calibration :-** ( \* ) Without Adjustment

**Cert. No.:** 20TM1760  
**Page.:** 3 of 3

**Function of UUC\* :** Temperature Source

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
20.0	20.0	20.0	0.57	0.50	1.3	0.94	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.665	20.672	20.484	20.447	20.467	20.547	20.436	20.391	20.348

**Average\* :** The average of 30 values in each position.

**Temperature stability :** One-half of the greatest maximum difference of measured temperature at any one sensor.

**Temperature uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

**Overall Variation :** The Difference of the maximum and minimum measured temperatures throughout observation.

**UUC\* :** Unit Under Calibration

**Note :** The reported uncertainty of measurement was included stability and excluded uniformity .

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

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*Maku .*





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Cert.No.: 20MM602

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance

**Manufacturer :** Mettler Toledo

**Model :** AB135-S

**Serial No. :** 1125133312

**ID No. :** SAF.LAB.001-2548

**Submitted by :** Safety Plan Co.,Ltd.  
1034 Moo 3, Rangsit-Pathumthani Road,  
T.Bangpoon, A.Muang,  
Pathumthani 12000

**Location :** Laboratory Room (Safety plan Co.,Ltd.)


**Received order :** 24 September 2020

**Calibration Date :** 24 September 2020

**Ambient Temperature :** 15 °C to 40 °C

**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Kunchit Promprat

**Approved by :**   
Approved Signatory

( ) Pornthippa Tameyakul  
( / ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 29 September 2020

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.





Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2009-0629ON-1

Cert.No.: 20MM602

Page: 2 of 3

**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

**Condition of this result of calibration**

1. Reference standard instruments:-

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Test report No.</u>	<u>Due date</u>
1) Standard Weight Set (E2	15884	24053	70RC007	MM-0189-19	17 Jan 2022

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

3. This result of calibration was made on requested at the point specified by customer.

4. This certificate is not certified for any commercial transaction.

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

- National Institute of Metrology (Thailand).

**Result of calibration** ( ) Without Adjustment ( \* ) After Adjustment by Internal Calibration

Range capacity :	0 g to 31 g	Resolution	0.00001 g
	31 g to 120 g	Resolution	0.0001 g

**Before Adjustment :**

<u>Applied Weight</u>	<u>Balance Reading</u>	<u>Correction</u>	<u>Measurement Uncertainty</u>	<u>Coverage Factor</u>
( g )	( g )	( g )	( $\pm$ mg )	( k )
30	30.00046	-0.00046	0.080	2.00
120	120.0018	-0.0018	0.29	2.00

**After Adjustment :**

1. Determination of the standard deviation of weighing machine ( n = 10 )

<u>Applied Weight</u>	<u>Standard Deviation</u>
( g )	of Reading ( g )
30	0.000023
120	0.00006

Malu.



Equipment : Electronic Balance  
 Condition As-Received : Used Item  
 Reference : 2009-0629ON-1

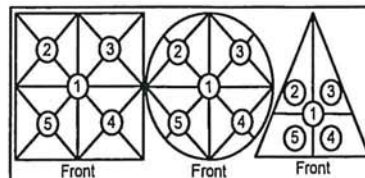
Cert.No.: 20MM602

Page: 3 of 3

### Result of calibration

#### 2. Effect of off center loading

A mass of 40 g was placed to various position on the pan.  
 The weighing machine reading error obtained is given in the table



Maximum difference between  
 off-center and central loading

Position 1 ( g )	Position 2 ( g )	Position 3 ( g )	Position 4 ( g )	Position 5 ( g )	( g )
+0.0003	+0.0001	+0.0002	+0.0004	+0.0002	0.0002

#### 3. Departure from nominal value

Applied Weight ( g )	Balance Reading ( g )	Correction ( g )	Measurement Uncertainty ( $\pm$ mg )	Coverage Factor ( k )
Unload	0.00000	0.00000	0.038	2.28
0.01	0.01001	-0.00001	0.038	2.28
0.05	0.05000	0.00000	0.038	2.28
0.1	0.10003	-0.00003	0.039	2.28
0.5	0.50001	-0.00001	0.039	2.28
1	1.00006	-0.00006	0.039	2.23
5	5.00002	-0.00002	0.041	2.17
10	10.00006	-0.00006	0.044	2.13
30	30.00015	-0.00015	0.080	2.00
60	60.0004	-0.0004	0.16	2.04
120	120.0005	-0.0005	0.29	2.00

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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Mahu.



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Cert.No.: 20MM603

Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance

**Manufacturer :** Mettler Toledo

**Model :** AB204-S/FACT

**Serial No. :** 1126481317

**ID No. :** SAF.LAB.018-2548

**Submitted by :** Safety Plan Co.,Ltd.  
1034 Moo 3, Rangsit-Pathumthani Road,  
T.Bangpoon, A.Muang,  
Pathumthani 12000

**Location :** Laboratory Room (Safety plan Co.,Ltd.)


**Received order :** 24 September 2020

**Calibration Date :** 24 September 2020

**Ambient Temperature :** 15 °C to 40 °C

**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Kunchit Promprat

**Approved by :**   
Approved Signatory

( ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :** 29 September 2020

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2009-0629ON-2

Cert.No.: 20MM603

Page: 2 of 3

**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

**Condition of this result of calibration**

1. Reference standard instruments:-

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Test report No.</u>	<u>Due date</u>
1) Standard Weight Set (E2	15884	24053	70RC007	MM-0189-19	17 Jan 2022

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

3. This result of calibration was made on requested at the point specified by customer.

4. This certificate is not certified for any commercial transaction.

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

- National Institute of Metrology (Thailand).

**Result of calibration** ( ) Without Adjustment ( \* ) After Adjustment by External Calibration

Range capacity : 0 g to 220 g Resolution 0.0001 g

**Before Adjustment :**

<u>Applied Weight</u>	<u>Balance Reading</u>	<u>Correction</u>	<u>Measurement Uncertainty</u>	<u>Coverage Factor</u>
( g )	( g )	( g )	( ± mg )	( k )
100	100.0021	-0.0021	0.21	2.03
200	200.0036	-0.0036	0.29	2.00

**After Adjustment :**

1. Determination of the standard deviation of weighing machine ( n = 10 )

<u>Applied Weight</u>	<u>Standard Deviation</u>
( g )	<u>of Reading ( g )</u>
100	0.00008
200	0.00005

*Make.*





Equipment : Electronic Balance  
 Condition As-Received : Used Item  
 Reference : 2009-0629ON-2

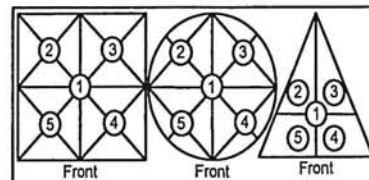
Cert.No.: 20MM603

Page: 3 of 3

### Result of calibration

#### 2. Effect of off center loading

A mass of 100 g was placed at various positions on the pan.  
 The weighing machine reading error obtained is given in the table



Maximum difference between  
 off-center and central loading

Position 1 ( g )	Position 2 ( g )	Position 3 ( g )	Position 4 ( g )	Position 5 ( g )	( g )
+0.0001	0.0000	+0.0007	+0.0003	-0.0003	0.0006

#### 3. Departure from nominal value

Applied Weight ( g )	Balance Reading ( g )	Correction ( g )	Measurement Uncertainty ( $\pm$ mg )	Coverage Factor ( k )
Unload	0.0000	0.0000	0.16	2.13
1	0.9999	+0.0001	0.16	2.13
2	2.0000	0.0000	0.16	2.13
5	5.0000	0.0000	0.16	2.13
10	10.0000	0.0000	0.16	2.13
25	25.0001	-0.0001	0.17	2.11
50	50.0001	-0.0001	0.17	2.11
75	75.0001	-0.0001	0.19	2.05
100	100.0001	-0.0001	0.21	2.03
150	149.9999	+0.0001	0.29	2.00
200	200.0000	0.0000	0.29	2.00

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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*Malu.*



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TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 20T2200

Page : 1 of 2

Equipment : Digital Thermometer With Sensor

Manufacturer: Union

Model : -

Serial No.: 10009864

ID No.: -

Condition As-Received: Used Item

Received Date: 25 September 2020

Calibration Date: 01 October 2020  
to 02 October 2020

Reference: 2009-0948DN

Submitted by: Safety Plan Co.,Ltd.

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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1034 Moo 3, Rangsit-Pathumthani Road, T.Bangpoon,  
A.Muang, Pathumthani 12000

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with  
Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Black Stack Thermometer	1560	8C454	201581	20 May 2021
2) PRT Scanner Module	2562	A01303	201581	20 May 2021
3) Industrial Platinum Resistance Thermometer	5627	739434	201581	20 May 2021

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

3.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Pitak Srimongkol

Issue Date : 07 October 2020

Approved Signatory :

[ ] Phalinee Prabpaipal

[ ] Chatchawan Khunpiluek

[✓] Wanlop Larpkurn



Cert. No.: 20T2200

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement

This equipment was connected with Thermocouple Type K

ID No. I0009864/T

<b>Immersion</b>	<b>Standard</b>	<b>UUC*</b>	<b>Uncertainty</b>	
<b><u>Depth</u></b>	<b><u>Temperature</u></b>	<b><u>Reading</u></b>	<b><u>Error</u></b>	<b><u>of Measurement</u></b>
( mm.)	( °C )	( °C )	( °C )	( ±°C )
150	3.9974	4.2	0.2026	0.41
150	19.9977	19.8	-0.1977	0.43

**UUC\* : Unit Under Calibration**

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

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## Certificate of Calibration

Certificate No. : 20T2221

Page : 1 of 2

Equipment : Liquid-in Glass Thermometer

Manufacturer: SK

Model : -

Serial No.: -

ID No.: SAF.LAB.003

Condition As-Received: Used Item

Received Date: 25 September 2020

Calibration Date: 02 October 2020  
to 07 October 2020

Reference: 2009-0948DN

Submitted by: Safety Plan Co.,Ltd.

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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1034 Moo 3, Rangsit-Pathumthani Road, T.Bangpooon,  
A.Muang, Pathumthani 12000

Procedure used: Calibration were conducted using in-house calibration procedure CP-T02 according to comparison with  
Platinum Resistance Thermometer (PRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Digital Thermometer	1529-R	B19520	20I711	16 Jun 2021
2) Platinum Resistance Thermometer	935-14-95	261589/2	20I711	16 Jun 2021

2.The UUC\* was immersed into liquid bath temperature controller and the top about 12 mm of the liquid column above the bath medium in every calibration points.

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

4.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Pitak Srimongkol

Issue Date : 09 October 2020

Approved Signatory :

☐ Phalinee Prabpaipal

☐ Chatchawan Khunpiluek

☒ Wanlop Larpkurn





Cert. No.: 20T2221

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:** Temperature measurement.

**Type:** Total Immersion

**Scale Division:** 1 °C

Reference point ( 0 °C ) Error = 0.4837 °C, with Uncertainty of Measurement of  $\pm 0.16$  °C

<b>UUC*</b>	<b>Standard</b>		<b>Uncertainty</b>
<b>Reading</b>	<b>Temperature</b>	<b>Error</b>	<b>of Measurement</b>
( °C )	( °C )	( °C )	( $\pm$ °C )
100	98.7464	1.2536	0.15

**Note:** UUC\* : Unit Under Calibration

The UUC\* readings were made under magnification and resolved to one tenth of one scale division.

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

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Cert.No.: 20CH1475

Page.: 1 of 2

## Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Digicon
Model :	WA-48SD
Serial No. :	Q821643
ID No. :	-
Condition As-Received:	Used Item
Received Date :	25 September 2020
Calibration Date :	01 October 2020
Reference :	2009-0948DN-1
Submitted by :	Safety Plan Co.,Ltd. 1034 Moo 3, Rangsit-Pathumthani Road, T.Bangpoon, A.Muang, Pathumthani 12000
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : CP-CH5 : based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Approved Signatory

- ( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ✓ ) Saithip Meangmai

Issue Date : 6 October 2020

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 20CH1475

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	19E3994	10 Oct 2020

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	699313	16 July 2022
pH 6.985	CPA chem	693947	12 June 2021
pH 10.008	CPA chem	693946	21 June 2021

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

**Calibration Results****Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ±mV )	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: Q821643	4.00	177.48	178	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.00	0.58	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 ( ± )	Coverage factor k
pH Electrode S/N.: TD50666	4.008	4.00	152	0.0079	2.00
	6.985	7.00	-20	0.0093	2.00
	10.008	10.01	-198	0.013	2.00

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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Saithip




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Cert.No.: 20CH1476

Page.: 1 of 2

## Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Digicon
Model :	WA-48SD
Serial No. :	Q821643
ID No. :	-
Condition As-Received:	Used Item
Received Date :	25 September 2020
Calibration Date :	30 September 2020
Reference :	2009-0948DN-2
Submitted by :	Safety Plan Co.,Ltd. 1034 Moo 3, Rangsit-Pathumthani Road, T.Bangpoon, A.Muang, Pathumthani 12000
Ambient Temperature :	(25 $\pm$ 2.5) °C
Relative Humidity :	(50 $\pm$ 15) %
Calibration Procedure:	In -house method : - CP-CH6 : based on direct measurement by using certified reference material (CRM)
Calibrated by :	Warakorn Lerngatrakul
Approved by :	 Approved Signatory
( ) Pornthippa Tameyakul	
( ) Malee Butkruea	
( <input checked="" type="checkbox"/> ) Saihip Meangmai	
Issue Date :	6 October 2020

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 20CH1476

Page.: 2 of 2

**Condition of this result of calibration**

**1. Reference Standard Instrument :-**

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	20I455	09 Apr 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 :-**

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
1.413 mS/cm	CPA chem	679457	12 Mar 2021

- Control Conductivity calibration solution temperature by Water bath (25+0.1) °C

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

**Calibration results**

**Function : Conductivity Measurement**

(\*) After Adjustment at 1.413 mS/cm

Conductivity Electrode Serial No.: Q821643

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ( $\pm$ )	Coverage factor k
1.413 mS/cm	1.370 mS/cm	1.413 mS/cm	0.0098 mS/cm	2.00

**Remark** - UUC\* = Unit Under Calibration

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

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*Saithip*



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## Certificate of Calibration

Certificate No. : 20H2301

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer

Manufacturer: Digicon

Model : TH-02

Serial No.: AF-87311

ID No.: SAF.LAB.004-2548

Condition As-Received: Used Item

Received Date: 25 September 2020

Calibration Date: 29 September 2020

Reference: 2009-0948DN

Submitted by: Safety Plan Co.,Ltd.

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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1034 Moo 3, Rangsit-Pathumthani Road, T.Bangpoon,  
A.Muang, Pathumthani 12000

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-H03 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	18540	28 Jul 2021
2) Standard Humidity/Temperature Meter	400	10240757	TH-0056-19	11 Dec 2020

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

3.This Certification is traceable to the International System of Unit maintained at:-

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Kraipop Onrat  
Issue Date : 30 September 2020

Approved Signatory :

☒ Chakrit Waewanjua

☐ Pornthippa Tameyakul

☐ Pitak Srimongkol



Cert. No.: 20H2301

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity measurement.

<u>Reference</u> <u>Temperature</u> (°C)	<u>Standard</u> <u>Humidity</u> (%R.H.)	<u>UUC*</u> <u>Reading</u> (%R.H.)	<u>Error</u> (%R.H.)	<u>Uncertainty</u> <u>of Measurement</u> (±%R.H.)
25.0	45.1	43	-2.1	1.3

**Result of Calibration:-**

Without Adjustment

Function:

Temperature measurement.

<u>Standard</u> <u>Temperature</u> (°C)	<u>UUC*</u> <u>Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> <u>of Measurement</u> (±°C)
25.00	24.9	-0.10	0.42

**UUC\*** : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%.

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## Certificate of Calibration

Certificate No. : 20M1952

Page : 1 of 2

Equipment : Standard Weights  
Manufacturer: -  
Model : -  
Serial No.: -  
ID No.: SAF.LAB.012-2548

Condition As-Received: Used Item  
Received Date: 25 September 2020  
Calibration Date: 01 October 2020

Reference: 2009-0948DN  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1007 mbar

Submitted by: Safety Plan Co.,Ltd.

1034 Moo 3, Rangsit-Pathumthani Road, T.Bangpoon,  
A.Muang, Pathumthani 12000

Procedure used: Calibration were conducted using in-house calibration procedure CP-M02 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m<sup>3</sup> and a temperature of 23 °C material density of weight is 8000 kg/m<sup>3</sup>.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard Weight Set (F1)	-	-	19M3001	24 Dec 2020

2.This certificate is not certified for any commercial transaction.


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

4.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwat Wutthicharoenmongkol  
Issue Date : 02 October 2020

Approved Signatory :

  
[ ] Phalinee Prabpaipal  
[x] Sura Suwannasri  
[ ] Chaowalit Rittirak



Cert No.: 20M1952

Page: 2 of 2

**Result of calibration**

Without adjustment

Nominal Value	Conventional mass		Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
50 g	50.00003	g	0.30 mg	1.0 mg
20 g	19.99987	g	0.25 mg	0.80 mg
20 g•	19.99968	g	0.25 mg	0.80 mg
10 g	10.00005	g	0.20 mg	0.60 mg
5 g	5.00015	g	0.16 mg	0.50 mg
2 g	2.00006	g	0.12 mg	0.40 mg
2 g•	2.00001	g	0.12 mg	0.40 mg
1 g	0.99999	g	0.10 mg	0.30 mg
500 mg	500.01	mg	0.080 mg	0.25 mg
* 200 mg	199.82	mg	0.060 mg	0.20 mg
200 mg•	200.02	mg	0.060 mg	0.20 mg
100 mg	99.99	mg	0.050 mg	0.16 mg
50 mg	49.941	mg	0.040 mg	0.12 mg

**Note :** \*Can not adjustment

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

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Cert.No.: 22CH1158

Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Eutech  
Model : pH 700  
Serial No. : 2858459  
ID No. : LB-Eq-027  
Condition As-Received: Used Item  
Received Date : 31 August 2022  
Calibration Date : 01 September 2022  
Reference : 2208-1091WN-1  
Submitted by : Special Lab Envi And Consultant Co.,Ltd  
47/91-93 Moo 3 Thambon Tha-it,  
Pakkret Nonthaburi 11120  
Ambient Temperature : (25  $\pm$  2.5) °C  
Relative Humidity : (50  $\pm$  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 : Warakorn Lernagtrakul

Approved by :

Approved Signatory

- (☒) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lernagtrakul

Issue Date : 6 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 22CH1158

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	43160066	130RC092	22E1223	13 Apr 2023

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	794120	14 Feb 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.008	CPA chem	823323	20 June 2023

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

**Calibration Results****Function : mV Measurement**

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( ±mV )	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: 2858459	4.00	177.48	177.4	4.01	0.058	2.00
	6.86	8.28	8.3	6.86	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00
	9.18	-128.97	-128.9	9.19	0.058	2.00
	10.00	-177.48	-177.4	10.01	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 ( ± )	Coverage factor <i>k</i>
pH Electrode S/N.: 3101624	4.008	4.01	177.4	0.0085	2.05
	6.985	6.99	3.0	0.0099	2.00
	10.008	10.01	-169.4	0.0092	2.00

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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Cert. No.: 22LM126

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** pH Meter with Sensor

**Manufacturer :** Eutech

**Model :** pH 700

**Serial No. :** 2858459

**ID No. :** LB-Eq-027

**Submitted by :** Special Lab Envi And Consultant Co.,Ltd  
47/91-93 Moo 3 Thambon Tha-it,  
Pakkret Nonthaburi 11120

**Location :** Chemistry Calibration Lab.2

**Received Order :** 31 August 2022

**Calibrated Date :** 1 September 2022

**Ambient Temperature :** (  $26 \pm 10$  ) °C

**Relative Humidity :** (  $50 \pm 30$  ) %

**AC Line Voltage :** (  $220 \pm 22$  ) V

**Calibrated by :** Warakorn Lerngagtrakul

**Approved by :**

*Malee*

Approved Signatory

- ( ) Pornthippa Tameyakul  
( ☒ ) Malee Butkruea  
( ) Suwit Imjai

**Issue Date :**

6 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0044921





Equipment : pH Meter with Sensor

Condition As-Received : Used Item

Reference : 2208-1091WN-2

Cert. No.: 22LM126

Page.: 2 of 2

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPRT ) into Temperature Bath.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	53 II B	20410013	22I555	06 May 2023

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

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: PH5TEMB01P

<u>Calibration Point</u> ( °C )	<u>Immersion Depth</u> ( mm )	<u>Standard Temperature</u> ( °C )	<u>UUC* Reading</u> ( °C )	<u>Error</u> ( °C )	<u>Uncertainty</u> ( ± °C )	<u>Coverage Factor</u> <i>k</i>
25.0	80	25.004	25.0	-0.004	0.16	2.00

**UUC\* :** Unit Under Calibration

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

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*Malu*



## Certificate of Calibration

**Certificate No. :** 65-400451-1

**Page : 1 of 2**

**Submitted by :** Special Lab Envi and Consultant Co., Ltd.  
47/91 Moo 3 Thambol Tha-it, Pakkret, Nonthaburi 11120

**Equipment :** Water Bath

Manufacturer : Memmert

Model : WNB22

Range : N/A °C

Resolution : 0.1 °C

Serial No. : L520.0201

ID No. : LB-Eq-041

**Environment :** On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (45 to 500) %

Line Voltage : (226.0 to 226.5) V

**Date of Received :** 24 August 2022

**Date of Calibration :** 24 August 2022

**Date of Issue :** 31 August 2022

**Calibrated by :** Permpon Chanpu

**Calibration Method :** This instrument was calibrated by In-house method CAL-M4006 based on ASTM E715-80  
The temperature scale used was based on ITS-90

**Reference Standard Instruments :** This certification is traceable to the International System of Units  
Standard Digital Thermometer with RTD probe

ID No.	Cert. No.	Due Date	Traceability
400029 & 400031	65-400273-1	23 Nov 2022	National Institute of Metrology Thailand (NIMT)

Approved by :

( Surachai Promthong )

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

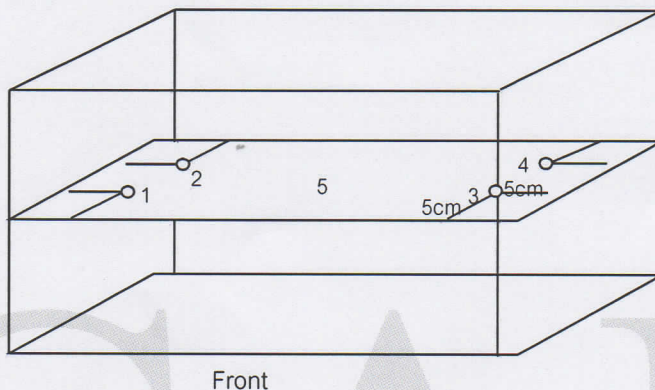
**Certificate No. : 65-400451-1**

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

**Function :** Temperature measurement



Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.					Uncertainty (± °C)	Measured Uniformity (°C)	Measured Stability (°C)
			1	2	3	4	5			
62.0	62.0	62.0	61.93	61.92	61.91	61.91	61.91	0.18	0.06	0.03
85.0	85.0	85.0	84.94	84.91	84.89	84.92	84.92	0.18	0.08	0.03
95.0	95.0	95.0	94.81	94.76	94.76	94.77	94.77	0.19	0.09	0.07
100.0	ccc	100.8	100.64	100.74	100.52	100.62	100.56	0.24	0.34	0.13

Remark The uncertainty is not combine uniformity of the water bath

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

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

- o0o -

*Handwritten signature*





## Certificate of Calibration

**Certificate No. :** 65-210421-1

**Page : 1 of 2**

**Submitted by :** Special Lab Envi And Consultant Co.,Ltd.  
47/91 Moo 3, Tambol Tha-IT, Pakkret, Nonthaburi 11120

**Equipment :** Weight  
Manufacturer : LS Material : Stainless Steel  
Weight size : 1 g  
ID No. : LB-Eq-034  
Assumed density of weight : 7950 kg / m<sup>3</sup>  
Assumed Air density : 1.2 kg / m<sup>3</sup>

**Environment :** Ambient Temperature : ( 20 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
Air Pressure : 1009.8 mbar

**Date of Received :** 01 September 2022

**Date of Calibration :** 05 September 2022

**Date of Issue :** 05 September 2022

**Calibrated by :** Wuttichai Swatphong

**Calibration Method :** In-house method CAL-M2101 based on OIML R 111-1 : 2004(E)

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E221-E2210	MM-0042-22	21 Mar 2025	National Institute of Metrology (Thailand), (NIMT)

Approved by :



( Surachai Promthong )

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 65-210421-1

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

No.	Nominal Value	Id.Mark	Conventional mass Value		Measuring Uncertainty
1	1 g	none	1 g	-0.028 mg	$\pm 0.023$ mg

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

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

- o0o -





## Certificate of Calibration

**Certificate No. :** 65-210421-2

**Page : 1 of 2**

**Submitted by :** Special Lab Envi And Consultant Co.,Ltd.  
47/91 Moo 3, Tambol Tha-IT, Pakkret, Nonthaburi 11120

**Equipment :** Weight  
Manufacturer : LS Material : Stainless Steel  
Weight size : 100 g  
ID No. : LB-Eq-035  
Assumed density of weight : 7950 kg / m<sup>3</sup>  
Assumed Air density : 1.2 kg / m<sup>3</sup>

**Environment :** Ambient Temperature : ( 20 ± 2 ) °C  
Relative Humidity : ( 50 ± 10 ) %  
Air Pressure : 1009.8 mbar

**Date of Received :** 01 September 2022

**Date of Calibration :** 05 September 2022

**Date of Issue :** 05 September 2022

**Calibrated by :** Wuttichai Swatphong

**Calibration Method :** In-house method CAL-M2101 based on OIML R 111-1 : 2004(E)

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E221-E2210	MM-0042-22	21 Mar 2025	National Institute of Metrology (Thailand), (NIMT)

Approved by :



( Surachai Promthong )

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

Certificate No. : 65-210421-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

No.	Nominal Value	Id.Mark	Conventional mass Value		Measuring Uncertainty
1	100 g	none	100 g	-0.05 mg	$\pm$ 0.11 mg

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

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

- o0o -

*PA*





## Certificate of Calibration

**Certificate No. :** 65-210421-3

**Page : 1 of 2**

**Submitted by :** Special Lab Envi And Consultant Co.,Ltd.  
47/91 Moo 3, Tambol Tha-IT, Pakkret, Nonthaburi 11120

**Equipment :** Weight

Manufacturer : LS

Material : Stainless Steel

Weight size : 200 g

ID No. : LB-Eq-036

Assumed density of weight : 7950 kg / m<sup>3</sup>

Assumed Air density : 1.2 kg / m<sup>3</sup>

**Environment :** Ambient Temperature : ( 20 ± 2 ) °C

Relative Humidity : ( 50 ± 10 ) %

Air Pressure : 1009.8 mbar

**Date of Received :** 01 September 2022

**Date of Calibration :** 05 September 2022

**Date of Issue :** 05 September 2022

**Calibrated by :** Wuttichai Swatphong

**Calibration Method :** In-house method CAL-M2101 based on OIML R 111-1 : 2004(E)

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E221-E2210	MM-0042-22	21 Mar 2025	National Institute of Metrology (Thailand), (NIMT)

Approved by :



( Surachai Promthong )

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 65-210421-3

**Page :** 2 of 2

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

No.	Nominal Value	Id.Mark	Conventional mass Value		Measuring Uncertainty
1	200 g	none	200 g	+0.09 mg	$\pm$ 0.17 mg

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

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

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*PA*





**BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., LTD.**  
**CALIBRATION LABORATORY**

300 Phaholyothin Road, Phayathai, Bangkok 10400, Thailand Tel: +66 2615-2929 Fax: +66 2615-2350-1  
E-mail: bkk@becthai.com Website: www.becthai.com



Certificate No. : CAL-22-614

Page : 1 of 3

## CERTIFICATE OF CALIBRATION

Equipment	:	Spectrophotometer
Manufacturer	:	Merck
Model	:	Prove 100
Serial No.	:	1809112938
ID No.	:	LB-Eq-031
Customer	:	Special Lab Envi And Consultant Co., Ltd.
	:	47/91-93 Moo 3, Tambol Tait,
	:	Amphur Pakrad, Nonthaburi, 11120
Location	:	Becthai Laboratory
Date of Receipt	:	17 August 2022
Date of Calibration	:	17 August 2022
Date of Issue	:	17 August 2022
Ambient Temperature	:	(25±10) °C
Relative Humidity	:	(60±20) %
Condition As-Received	:	Used Item

Calibrated by

( Ms. Nopparat Suntarotayan )

Calibration Engineer

Approved by

( Ms. Jintana Sangthaijaroenlap )

Calibration Manager

The reported expended uncertainty of measurement was based on a combined standard uncertainty multiplied by a coverage factor  $k=2.00$ , providing a level of confidence of approximately 95%.

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Indicated values are valid for the state of the Spectrophotometer at the time of calibration only.





**BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., LTD.**  
**CALIBRATION LABORATORY**

300 Phaholyothin Road, Phayathai, Bangkok 10400, Thailand Tel: +66 2615-2929 Fax: +66 2615-2350-1  
E-mail: bkk@becthai.com Website: www.becthai.com



Certificate No. : CAL-22-614

Page : 2 of 3

## CALIBRATION REPORT

### Conditions of this result of calibration

#### 1. Reference Standard Material :

<u>Material</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert.No.</u>	<u>Due date</u>
Holmium Glass Filter	RM-HG	24563	90313	2 Mar 23
Neutral Density Filter	RM-1N2N3N	24568	90324	3 Mar 23

#### 2. Traceability : This certification is traceable to the International System of Unit maintained at;

The Starna Scientific Ltd. Accredited Calibration Laboratory No. 0659.

#### 3. Method of calibration :

The calibration procedure was carried out according to the Guide to CPM-CAL-02 based on ASTM E275-08 (2013) and-  
ASTM E925-09 (2014).

#### 4. Result of calibration :

( ☒ ) without adjustment

( ☐ ) after adjustment

#### 5. Equipment Specifications:

Spectral Bandwidth :	4	nm
Data Interval :	1	nm
Scan Speed :	N/A	nm/min





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300 Phaholyothin Road, Phayathai, Bangkok 10400, Thailand Tel: +66 2615-2929 Fax: +66 2615-2350-1  
E-mail: bkk@becthai.com Website: www.becthai.com



Certificate No. : CAL-22-614

Page : 3 of 3

## CALIBRATION REPORT

### Wavelength Calibration

Certified Values of Reference Material (nm)	Nominal Value (nm)	UUC*Reading (nm)	Error (nm)	Uncertainty of Measurement ( $\pm$ nm)
418.48	418.48	418	-0.48	0.59
536.90	536.90	536	-0.90	0.59
637.94	637.94	638	0.06	0.59

### Photometric Calibration for Visible

Wavelength (nm)	Certified Values of Reference Material (A)	UUC* Reading (A)	Error (A)	Uncertainty of Measurement ( $\pm$ A)
420.0	Zero	0.000	0.0000	0.0028
	0.5824	0.583	0.0006	0.0044
	0.7266	0.726	-0.0006	0.0041
	1.0377	1.036	-0.0017	0.0040
440.0	Zero	0.000	0.0000	0.0028
	0.5659	0.566	0.0001	0.0042
	0.7126	0.712	-0.0006	0.0038
	1.0172	1.015	-0.0022	0.0037
465.0	Zero	0.000	0.0000	0.0028
	0.5256	0.526	0.0004	0.0044
	0.6705	0.670	-0.0005	0.0035
	0.9562	0.956	-0.0002	0.0035
546.1 (546.0)	Zero	0.000	0.0000	0.0028
	0.5236	0.523	-0.0006	0.0036
	0.6962	0.695	-0.0012	0.0032
	0.9933	0.990	-0.0033	0.0033
590.0	Zero	0.000	0.0000	0.0028
	0.5578	0.557	-0.0008	0.0036
	0.7523	0.751	-0.0013	0.0032
	1.0747	1.071	-0.0037	0.0033
635.0	Zero	0.000	0.0000	0.0028
	0.5655	0.565	-0.0005	0.0036
	0.7321	0.731	-0.0011	0.0031
	1.0454	1.042	-0.0034	0.0031

Remark : Each individual filter is measured against the empty filter holder (blank) used to zero the Spectrophotometer.

#### Note:

UUC\* : Unit Under Calibration

- End of Report -



# PinAAcle 900F Preventive Maintenance Report

Company Name: SPECIAL LAB ENVI & CONSULTANT

Instrument Location: 47/91 หมู่ 3 หมู่บ้านที่แลนค์


ต.ท่าอิฐ. อ.ปากเกร็ดจ.นนทบุรี 11120

Instrument Serial No.: PFBS17082303

Date: 06-Sep-2022

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

<b>Company Name:</b>	SPECIAL LAB ENVI & CONSULTANT		
<b>Address (Instrument Location):</b>	47/91 หมู่ 3 หมู่บ้านที่แลนค์ ต.ท่าอิฐ อ.ปากเกร็ด จ.นนทบุรี 11120		
<b>Serial Number:</b>	PFBS17082303	<b>PM Number:</b>	1/1
<b>Customer Name (if applicable):</b>	-	<b>Telephone Number:</b>	-
<b>Customer Support Engineer Name:</b>	Pattrayut W.	<b>Service Order Number:</b>	WO-01892933
<b>Date PM Performed: (DD-MMM-YYYY)</b>	Sep 6, 2022	<b>Next PM Due Date: (DD-MMM-YYYY)</b>	Sep 6, 2023
<b>Standard Labor Hours to Complete PM :</b>		<b>5 hours</b>	

Part Number	Release	Publication Date	
09370145 Rev.9	A	January 2018	

### **Scope**

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

The customer should save their method before the PM begins.

### **General Instructions:**

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

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

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

Update the PM sticker and instrument logbook as required.

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## Component List

Component / Specific Model	Serial #	Configuration Notes

## Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	2
N3160156	O-Ring Kits for Sampling Introduction ( Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction ( Plastic Nebulizer)	2
N9301714	Replacement Acetylene Filter Cartridge	1
TH001022	Replacement Air Filter Cartridge	2

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	25-76CUY1	30-Oct-2022

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

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MG0-056
N1013002	1.0A Neutral density filter	1	MG2-258
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	03030997
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190

# Procedure Checklist

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

## 1. General:

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

## 2. PC Instrument Software:

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

## 3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas lines for leaks and/or wear. Replace if needed.
- ☒ Clean exterior of the instrument.
- ☒ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ☒ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ☒ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Visually check for proper flame conditions when igniting the Air-C<sub>2</sub>H<sub>2</sub> and N<sub>2</sub>O-C<sub>2</sub>H<sub>2</sub> flames (if applicable).

## 4. Electrical:

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

## 5. Optics:

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

## 6. Gasses:

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



## 7. Flame Interlock Check:

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

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

## 8. After PM Performance tests:

### 8.1 Detector Linearity with Barium

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

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	1.0309	0.9928	Passed
0.2 A ND Filter	± 5% from Cert.	0.1857	0.1869	Passed

### 8.2 Baseline Noise at 1.0 Absorbance with Barium

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

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0008	Passed

### 8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

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

#### 8.4 D<sub>2</sub> Background Compensation with Copper

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

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

#### 8.5 AA-BG Baseline Noise with Copper

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

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0003	Passed

#### 8.6 AA-BG Baseline Noise with Arsenic

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

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0012	Passed

#### 8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	N/A	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3347	Passed

#### 10. Review:

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

## Additional Comments

### Additional Comments Regarding the PM

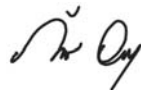
## Review

*The preventive maintenance checks and if applicable performance tests for PinAAcle 900F have been completed.*

*This PinAAcle 900F Passes ☒ Fails ☐ the preventive maintenance.*

### Review of Preventive Maintenance:

Authorized PerkinElmer Representative:



Date:

06-Sep-2022

(DD-MMM-YYYY)

Authorized Customer Representative:



Date:

06-Sep-2022

(DD-MMM-YYYY)