
เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



Certificate of Calibration

Equipment: Balance
Model: BSA224S-CW
Serial No. (or ID.): 28092544 (INS/LB-109)
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01233119
Issued Date: 04 September 2023
Job No.: WO-00004422
Page: 1 of 2

Customer: THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Environment Condition: Temperature 25 °C ± 0.3 °C
Humidity 52 %RH ± 4.2 %RH

Calibration Place: THAI CHEMICAL & ENGINEERING CO., LTD. (Laboratory)
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Polawad Ruamrup

Calibration Date: 04 September 2023

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02222418

(Mr. Polawad Ruamrup)

Person in charge

(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C01-14: 12 Sep 2022

Certificate No.: C01233119

Page: 2 of 2

Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.

			Nominal Test Value	100	(g)
Reference Points (g)					
A	B	C	D	E	
-	0.0000	0.0001	0.0000	-0.0001	

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00006

Error of Indication from nominal or conventional mass value., Readability 0.0001 (g)

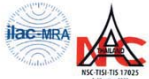
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.00000	1.0000	0.0000	0.00011	2.04
2	2.00001	2.0000	0.0000	0.00011	2.04
5	4.99999	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	19.99998	20.0000	0.0000	0.00012	2.03
50	49.99994	49.9999	0.0000	0.00013	2.02
100	99.99997	100.0000	0.0000	0.00017	2.01
120	119.99995	119.9999	-0.0001	0.00021	2.00
150	149.99991	149.9999	0.0000	0.00024	2.00
200	199.99993	200.0000	0.0001	0.00030	2.00

The End of Certificate

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2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
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CAL-FM-C01-14: 12 Sep 2022



Certificate of Calibration

Equipment: Liquid Bath
Model: WNE 14
Serial No. (or ID.): L418.0212 (INS/LB-154)
Manufacturer: Memmert
Condition: In Condition
Forced Circulation: None

Certificate No.: C13240087
Issued Date: 01 March 2024
Job No.: WO-00019023
Page: 1 of 4

Customer: THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai, Prakanong,
Bangkok 10260 Thailand

Environment Condition: Temperature: 25 °C ± 0.6 °C
Humidity: 49 %RH ± 5.8 %RH
Voltage: 225 VAC ± 1.6 VAC

Calibration Place: THAI CHEMICAL & ENGINEERING CO., LTD. (Laboratory)
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai, Prakanong,
Bangkok 10260 Thailand

Calibration By: Mr. Preecha Phoosaisai

Calibration Date: 01 March 2024

The Method used: In house method, CAL-WI-17, base on ASTM E715-80

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited. Certificate No. C10230010

(Mr. Preecha Phoosaisai)

Person in charge

(Mr. Udon Srichana)

Authorized signatory

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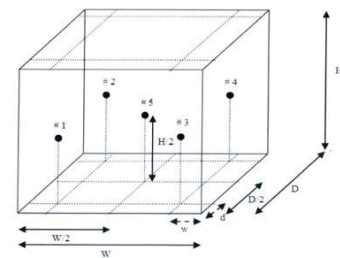
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2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C13-13: 12 Sep 2022

Certificate No.: C13240087

Page: 2 of 4



Standard Installation Locations

Midway between the diffuser plate and the water surface

Inside bath: W = 36 (cm) D = 32 (cm) H = 16 (cm) Volume = 18 (Liters)

Standard Locations #1: w = 5 (cm) d = 5 (cm)

Standard Locations #2: w = 5 (cm) d = 5 (cm)

Standard Locations #3: w = 5 (cm) d = 5 (cm)

Standard Locations #4: w = 5 (cm) d = 5 (cm)

Standard Locations #5: Center of any probes. (#1 - #4)

Position of Std	#1	#2	#3	#4	#5
Channel of Logger	101	102	103	104	109

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the bath.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the bath at steady-state. The reference probe is preferably located in the geometric center of the bath.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

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DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C13-13: 12 Sep 2022

Calibration Results: Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 60.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	59.92	-0.08	0.17
#2	60.01	0.01	0.21
#3	59.92	-0.08	0.18
#4	59.99	-0.01	0.19
#5	60.01	0.01	0.21

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)					Uncertainty (± °C)*
			#1	#2	#3	#4	#5	
60.0	60.0	60.0	59.92	60.01	59.92	59.99	60.01	0.21

Bath Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
60.0	0.20	0.07	0.24

Note: * Maximum uncertainty of the each position

Without adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 85.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	84.86	-0.14	0.21
#2	84.98	-0.02	0.24
#3	84.82	-0.18	0.23
#4	84.91	-0.09	0.22
#5	84.93	-0.07	0.20

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)					Uncertainty (± °C)*
			#1	#2	#3	#4	#5	
85.0	85.0	85.0	84.86	84.98	84.82	84.91	84.93	0.24

Bath Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
85.0	0.21	0.09	0.36

Note: * Maximum uncertainty of the each position

The End of Certificate

BUCHI (Thailand) Ltd. ASEAN Competence Center

77/121 Sin Sathorn Tower
28th FL, Krungthornburi Rd.
Klongtonnai, Klongsan
Bangkok 10600
P +662 862 0851
F +662 862 0854
bacc@buchi.com
www.buchi.com

Preventive Maintenance Scrubber

Service No. PM24-S08-041

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท วิศวกรรมเคมี จำกัด 1048/2 ซ.สุขุมวิท 66/1 ถ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร 10260	K-415	1000122494	28 Feb 2024 PM 1/2
คุณชัยภรณ์ Tel: 084-463-8741 Fax:			

2. Instrument

2.1 Cooling water (If it connected)	OK	NOT OK	Remark
- Temperature 10 - 20 °C	/		
- Cooling water inlet	/		
- Cooling water outlet	/		

2.2 Cleaning	DONE	NOT DONE	Remark
- Housing	/		
- Condenser	/		
- Swirl disc	/		

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77/121 Sin Sathorn Tower
28th FL, Krungthornburi Rd.
Klongtonnai, Klongsan
Bangkok 10600
P +662 862 0851
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Preventive Maintenance Scrubber

2.3 Visual Check	OK	NOT OK	Remark
- Hose connection to suction	/		
- Glassware	/		
- Lip gasket	/		
- GL-14 connector	/		
- Activated charcoal	/		

2.4 Flush Pump

- Make sure, the bypass valve is closed completely (for maximum suction power).
- Disconnect the silencer, move it down (or take it away from the instrument), and flush out the pump with at least 500 mL of distilled water through the pump inlet, until the collected washing water is clean.
 - Switch on the instrument and collect the waste water from the pump output in a suitable vessel.

Flush pump ☒ OK ☐ NOT OK

2.5 Washing Solution

- Sodium hydroxide 8-10 %, max. 20 %
- Sodium carbonate
 - dissolve 600 g Na₂CO₃ in 3 L distilled warm water, or
 - dissolve 1.7 kg Na₂CO₃ in 10 H₂O in 3 L distilled warm water

Washing solution ☒ OK ☐ NOT OK

Preventive Maintenance Scrubber

3. Summary

All specifications OK	Specification not OK
PASS	

Comments

PM1-2
- เครื่องใช้งานได้ปกติ

Signature BUCHI

- Service by veerid Date 28 Feb 2024

- Approve by Suraphan C. Date 7 Mar 2024



Preventive Maintenance Kjeldahl

Service No. PM24-S08-041

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท วิศวกรรมเคมี จำกัด 1048/2 ซ.สุขุมวิท 66/1 ถ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร 10260	K-350	1000117313	28 Feb 2024 PM 1/2
คุณณัฐญารัตน์ Tel: 084-463-8741 Fax:			

2. Instrument

2.1 Cooling water (if it connected)	OK	NOT OK	Remark
- Temperature 15 – 20 °C	/		
- Cooling water inlet	/		
- Cooling water outlet	/		
- Control Temperature	/		

2.2 Cleaning	DONE	NOT DONE	Remark
- Outside Instrument	/		
- Inside Instrument	/		
- Splash protector	/		
- Condenser	/		



Preventive Maintenance Kjeldahl

2.3 Visual Test	OK	NOT OK	Remark
- Screw Coupling (between splash protector and condenser)	/		
- Condenser	/		
- Splash protector	/		
- Hypalon connection (connection tube)	/		
- Rubber bung	/		
- Ventilation valve	/		
- PTFE tube	/		
- Cooling water inlet	/		
- Cooling water outlet	/		
- Magnetic valve	/		

2.4 System control	OK	NOT OK	Remark
- Key board	/		
- Display	/		
- Program	/		
- Adding H ₂ O	-		
- Adding NaOH	/		
- Adding H ₃ BO ₃	-		
- Aspiration	-		



Preventive Maintenance Kjeldahl

2.5 System Distillation	OK	NOT OK	Remark
- Boiler	/		
- Water level sensor	/		
- One way valve	/		
- Pressure switch	/		
- Thermostat	/		
- Steam valve1 (Y4)	/		
- Steam valve2 (Y5)	/		
- Drain valve (Y3)	-		
- Water 3/2 way valve (Y1)	-		

2.6 Hose	OK	NOT OK	Remark
- Unisil hose	/		
- Hypalon hose	/		
- Drain hose	-		
- Viton hose	/		
- Silicone hose	/		

2.7 Diaphragm pump	OK	NOT OK	Remark
- Diaphragm pump for H ₂ O	-		
- Diaphragm pump for NaOH	/		
- Diaphragm pump for H ₃ BO ₃	-		

2.8 Program test	OK	NOT OK	Remark
- Distillation	/		
- Aspiration	-		
- Preheating	/		
- Cleaning	/		



Preventive Maintenance Kjeldahl

3. Function Test

Addition H ₂ O	0 ml	Reaction time	0 min
Addition NaOH	0 ml	Distillation time	5 min
Addition H ₃ BO ₃	0 ml	Steam capacity	100%
		Aspiration	SAM
Result: Water in receiving vessel now approximately 164 ml, 165 ml			

4. Summary

All specifications OK	Specification not OK
Pass	

Comments

PM1-2
- เครื่องใช้งานได้ปกติ

Signature BUCHI

- Service by Veerid Date 28 Feb 2024
- Approve by Sunghun C. Date 7 Mar 2024



Preventive Maintenance IR Digestion

Service No. PM24-S08-041

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท วิศวกรรมเคมี จำกัด 1048/2 ซ.สุขุมวิท 66/1 ถ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร 10260	K-436	1000122502	28 Feb 2024 PM 1/2
คุณณัฐณารัตน์ Tel: 084-463-8741 Fax:			

2. Instrument

2.1 Housing	OK	NOT OK	Remark
- Clean the housing	/		
- Visual check	/		
- Check for defects (e.g. cracks)	/		

2.2 Heating	OK	NOT OK	Remark
- Clean insulation plate	/		
- Visual check	/		
- Check heating element	/		



Preventive Maintenance IR Digestion

2.3 Visual Check	OK	NOT OK	Remark
- Connection to suction	/		
- PTFE seal	/		
- O-ring	/		
- Glass holder set	/		
- Suction module	/		

2.4 System control (for K-439 only)	OK	NOT OK	Remark
- Keyboard	/		
- Display	/		
- Program	/		



Preventive Maintenance IR Digestion

3. Summary

All specifications OK	Specification not OK
PASS	

Comments

PM1-2
- เครื่องใช้งานได้ปกติ

Signature BUCHI

- Service by Veerid Date 28 Feb 2024
- Approve by Sunghun C. Date 7 Mar 2024





Certificate of Calibration



Certificate No.: C07240086 Page 3 of 3

Equipment: pH METER
Model: SevenCompact S220
Serial No. (or ID.): B914466655
Manufacturer: Mettler Toledo
Electrode Serial No.: 3021943
Condition: In Condition

Certificate No.: C07240086
Issued Date: 21 February 2024
Job No.: WO-00017105
Page: 1 of 3
Model: InLab Expert Pro-ISM **Brand:** Mettler Toledo

Customer: THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai, Prakanong,
Bangkok 10260 Thailand

Environment Condition: Temperature 23 °C ± 2 °C
Humidity 50 %RH ± 15 %RH

Calibration Place: Environment Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Miss.Orawan Khlaiphloi
Calibration Date: 16 February 2024
The Method used: In house method, CAL-WI-58, base on ASTM E 70-07
Traceability: This certificate is traceable to SI Units, Sample Test is assured through primary measurement method Harned cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 931983, 931985, 931984 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20230264EA

Orawan

(Miss Orawan Khlaiphloi)
Person in charge

Nitinun

(Mr. Nitinun Srihawan)
Authorized signatory

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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C07-13: 12 Sep 2022

Electrode Test Results*

The three-point calibration using three standard buffer solutions; pH 4.008, pH 6.985 and pH 9.997
- During calibration, display of pH meter can be adjust to reading; pH 4.008, pH 6.985 and pH 9.997
The practical slope of the pH electrode; 58.81 (mV/pH), 99.41%
The zero point of the pH electrode; 7.10 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	4.008	0.000	0.0070	2.00
6.985	6.988	0.003	0.0075	2.00
9.997	9.999	0.002	0.0070	2.00

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

The End of Certificate

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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
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CAL-FM-C07-13: 12 Sep 2022

Certificate No.: C07240086 Page 2 of 3



Calibration Results:

pH Scale

Input (mV)	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	Error (mV)	(pH)		
414.12	414.1	-0.02	0.001	0.065	2.00
354.96	354.9	-0.06	1.001	0.065	2.00
295.8	295.8	0.00	2.001	0.065	2.00
236.64	236.6	-0.04	3.001	0.065	2.00
177.48	177.5	0.02	4.001	0.065	2.00
118.32	118.4	0.08	5.000	0.065	2.00
59.16	59.2	0.04	6.000	0.065	2.00
0	0.1	0.10	7.000	0.065	2.00
-59.16	-59.1	0.06	8.000	0.065	2.00
-118.32	-118.2	0.12	9.000	0.065	2.00
-177.48	-177.3	0.18	10.000	0.065	2.00
-236.64	-236.5	0.14	11.001	0.065	2.00
-295.8	-295.6	0.20	12.000	0.065	2.00
-354.96	-354.8	0.16	12.000	0.065	2.00
-414.12	-413.9	0.22	14.000	0.065	2.00



Certificate of Calibration

Equipment: Digital Thermometer with Probe
Model: Seven Compact S220
Serial No.: B914466655
Manufacturer: Mettler Toledo
Condition: In Condition

Certificate No.: C15240250
Issued Date: 16 February 2024
Job No.: WO-00017105
ID No.: -
Page: 1 of 2

Customer: THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Environment Condition: Temperature: 22 °C ± 3 °C
Humidity: 50 %RH ± 20 %RH
Voltage: 220 VAC ± 10 %

Calibration Place: Thermo-Hygro Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Mr. Tweewong Thaihiang
Calibration Date: 16 February 2024
The Method used: In house method, CAL-WI-19, by comparison with standard thermometer
Traceability: This certificate is traceable to the International System of Unit maintained by Quality Reborn Co.,Ltd. (QR) Certificate No. QR23-1073

(Mr. Tweewong Thaihiang)
Person in charge

(Mr. Pramote Ramrong)
Authorized signatory

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DKSH Technology Limited
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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C07-13: 12 Sep 2022

หน้า 2 จาก 3

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 สุขุมวิท ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C15-14: 06 Dec 2022

Calibration Results:

Without Adjustment

Sensor Type: RTD

Channel: -

Diameter (mm): 12

Length (mm): 120

Immersion (mm): 110

Calibrate Point (°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)	Uncertainty (± °C)
20.0	20.077	20.0	0.077	0.076
25.0	25.073	25.0	0.073	0.076
30.0	30.076	30.0	0.076	0.076

The End of Certificate



Certificate of Calibration

Equipment:

Model: IN55
Serial No.(or ID): D215.1344 (INS/LB-022)
Manufacturer: Memmert
Condition: In Condition
Shelves(pc.): 1

Incubator

Certificate No.: C31231887
Issued Date: 04 September 2023
Job No.: WO-00004422
Page: 1 of 3
Ventilation Valve: Closed

Customer:

THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai, Prakanong
Bangkok 10260 Thailand

Environment Condition:

Temperature: 27 °C ± 1.5 °C
Humidity: 53 %RH ± 6.6 %RH
Voltage: 228 VAC ± 1.7 VAC

Calibration Place:

THAI CHEMICAL & ENGINEERING CO., LTD. (Laboratory)
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai, Prakanong
Bangkok 10260 Thailand

Calibration By:

Mr. Nakin Ruenros

Calibration Date:

04 September 2023

The Method used:

In house method, CAL-WI-16, base on TLAS-G20

Traceability:

This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230009

(Mr. Nakin Ruenros)

Person in charge

(Mr. Udon Srichana)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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DKSH Technology Limited
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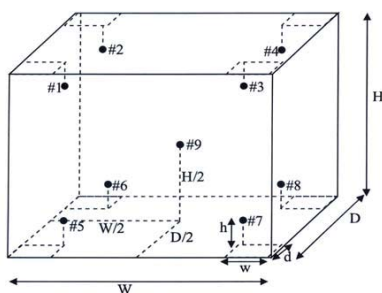
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CAL-FM-C31-10: 12 Sep 2022

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CAL-FM-C15-14: 06 Dec 2022



Standard Installation Locations

Volume (Calibration Zone)= 21 (Liters)

Inside chamber: W = 40 (cm) D = 33 (cm) H = 40 (cm)

Standard Locations (#1, #2, #3, #4): w = 5 (cm) d = 5 (cm) h = 5 (cm)

Standard Locations (#5, #6, #7, #8): w = 5 (cm) d = 5 (cm) h = 5 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	201	202	203	204	205	206	207	208	209

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.**Measured Temperature:** The average reading of standards at any positions or location.**Measured Uniformity:** The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.**Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.**Overall Variation:** The difference of maximum and minimum measured temperatures throughout observation time.

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DKSH Technology Limited
2533 สุขุมวิท 66/1 ถนนสุขุมวิท กรุงเทพมหานคร 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C31-10: 12 Sep 2022

ภาคผนวก ข - 6

Calibration Results:

Before adjustment

Setting: Indicating: #1: #2: #3: #4: #5: #6: #7: #8: #9:
45.0 45.0 44.74 44.67 44.70 44.78 44.51 44.55 44.49 44.80 44.75

After adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 45.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	45.22	0.22	0.23
#2	45.14	0.14	0.23
#3	45.25	0.25	0.23
#4	45.32	0.32	0.23
#5	45.01	0.01	0.23
#6	45.15	0.15	0.23
#7	45.02	0.02	0.23
#8	45.28	0.28	0.23
#9	45.32	0.32	0.23

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
45.0	45.0	45.0	45.22	45.14	45.25	45.32	45.01	45.15	45.02	45.28	45.32	0.23

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
45.0	0.36	0.06	0.39

Note: * Maximum uncertainty of the each position

The End of Certificate

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DKSH Technology Limited
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CAL-FM-C31-10: 12 Sep 2022



Certificate of Calibration

Represent to Certificate of Calibration No. C31232311

Equipment: Incubator Certificate No.: C31240764
Model: IN 55 Issued Date: 09 April 2024
Serial No.(or ID): D219.0767 (INS/LB 145) Job No.: WO-00009089
Manufacturer: Memmert Page: 1 of 3
Condition: In Condition Ventilation Valve: Closed
Shelves(pc.): 1

Customer: THAI CHEMICAL & ENGINEERING CO., LTD
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Environment Condition: Temperature: 25 °C ± 0.7 °C
Humidity: 57 %RH ± 4.9 %RH
Voltage: 226 VAC ± 3.3 VAC

Calibration Place: THAI CHEMICAL & ENGINEERING CO., LTD (Laboratory)
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Suphanimit Khamnophom
Calibration Date: 07 November 2023

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230001

(Mr. Suphanimit Khamnophom)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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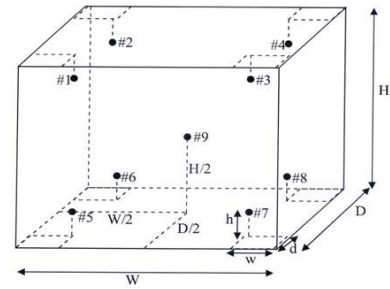
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2533 สุขุมวิท 66 ถนนสุขุมวิท กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C31-10: 12 Sep 2022

Certificate No.: C31240764

Page: 2 of 3



Standard Installation Locations

Volume (Calibration Zone)= 21 (Liters)

Inside chamber: W = 40 (cm) D = 33 (cm) H = 40 (cm)

Standard Locations (#1, #2, #3, #4): w = 5 (cm) d = 5 (cm) h = 5 (cm)

Standard Locations (#5, #6, #7, #8): w = 5 (cm) d = 5 (cm) h = 5 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	301	302	303	304	305	306	307	308	309

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 สุขุมวิท 66 ถนนสุขุมวิท กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
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CAL-FM-C31-10: 12 Sep 2022

Calibration Results:
Without adjustment

Certificate No.: C31240764

Page: 3 of 3

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 35.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	35.15	0.15	0.23
#2	35.21	0.21	0.23
#3	35.23	0.23	0.23
#4	35.15	0.15	0.23
#5	34.93	-0.07	0.23
#6	34.96	-0.04	0.23
#7	34.95	-0.05	0.23
#8	35.34	0.34	0.24
#9	35.23	0.23	0.23

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
35.0	35.0	35.0	35.15	35.21	35.23	35.15	34.93	34.96	34.95	35.34	35.23	0.24

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
35.0	0.36	0.10	0.55

Note: * Maximum uncertainty of the each position

The End of Certificate

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CAL-FM-C31-10: 12 Sep 2022



Certificate of Calibration

Represent to Certificate of Calibration No. C31232310

Equipment: Hot Air Oven Certificate No.: C31240750
Model: UF 55 Issued Date: 02 April 2024
Serial No.(or ID): B219.1995 (INS/LB 149) Job No.: WO-00009089
Manufacturer: Memmert Page: 1 of 4
Condition: In Condition Ventilation Valve: Closed
Shelves(pc.): 2

Customer: THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Environment Condition: Temperature: 22 °C ± 1.0 °C
Humidity: 54 %RH ± 4.7 %RH
Voltage: 224 VAC ± 1.6 VAC

Calibration Place: THAI CHEMICAL & ENGINEERING CO., LTD. (Laboratory)
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Bovon Jannantha
Calibration Date: 07 November 2023

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230015

(Mr. Bovon Jannantha)
Person in charge

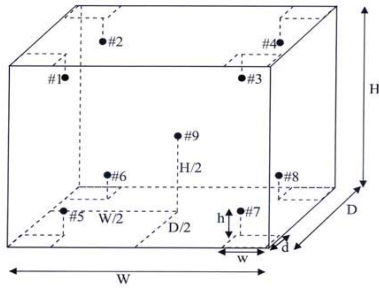
(Mr. Udon Srichana)
Authorized signatory

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2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
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CAL-FM-C31-10: 12 Sep 2022



Standard Installation Locations

Volume (Calibration Zone)= 21 (Liters)

Inside chamber: W = 40 (cm) D = 33 (cm) H = 40 (cm)

Standard Locations (#1, #2, #3, #4): w = 5 (cm) d = 5 (cm) h = 5 (cm)

Standard Locations (#5, #6, #7, #8): w = 5 (cm) d = 5 (cm) h = 5 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	201	202	203	204	205	206	207	208	209

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

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DKSH Technology Limited
2533 สุขุมวิท 66/1 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
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CAL-FM-C31-10: 12 Sep 2022

Calibration Results:

Before adjustment

Setting: Indicating: #1: #2: #3: #4: #5: #6: #7: #8: #9:
104.0 104.0 103.69 103.78 104.05 103.78 103.51 103.33 103.23 103.90 103.68

After adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 104.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	104.14	0.14	0.39
#2	104.17	0.17	0.39
#3	104.46	0.46	0.39
#4	104.21	0.21	0.39
#5	103.92	-0.08	0.39
#6	103.77	-0.23	0.39
#7	103.66	-0.34	0.39
#8	104.31	0.31	0.39
#9	103.91	-0.09	0.39

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
104.0	104.0	104.0	104.14	104.17	104.46	104.21	103.92	103.77	103.66	104.31	103.91	0.39

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104.0	0.59	0.13	0.99

Note: * Maximum uncertainty of the each position

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CAL-FM-C31-10: 12 Sep 2022

After adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 180.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	180.29	0.29	0.42
#2	180.37	0.37	0.42
#3	180.81	0.81	0.42
#4	180.21	0.21	0.42
#5	179.87	-0.13	0.42
#6	179.55	-0.45	0.42
#7	179.69	-0.31	0.42
#8	180.17	0.17	0.42
#9	180.18	0.18	0.42

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
180.0	180.0	180.0	180.29	180.37	180.81	180.21	179.87	179.55	179.69	180.17	180.18	0.42

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180.0	0.67	0.12	1.37

Note: * Maximum uncertainty of the each position

The End of Certificate

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2533 สุขุมวิท 66/1 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
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CAL-FM-C31-10: 12 Sep 2022



Certificate of Calibration

Equipment: Cooled Incubator
Model: IPP750 eco
Serial No.(or ID): V821.0094 (INS/LB-158)
Manufacturer: Memmert
Condition: In Condition
Shelves(pc.): 3
Certificate No.: C31240527
Issued Date: 06 March 2024
Job No.: WO-00019023
Page: 1 of 3
Ventilation Valve: None

Customer: THAI CHEMICAL & ENGINEERING CO., LTD.
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Environment Condition: Temperature: 19 °C ± 1.2 °C
Humidity: 46 %RH ± 5.8 %RH
Voltage: 224 VAC ± 1.8 VAC

Calibration Place: THAI CHEMICAL & ENGINEERING CO., LTD. (Laboratory)
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,
Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Sittiphong Lekfu
Calibration Date: 01 March 2024
The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230022

(Mr. Sittiphong Lekfu)

Person in charge

(Mr. Udon Srichana)

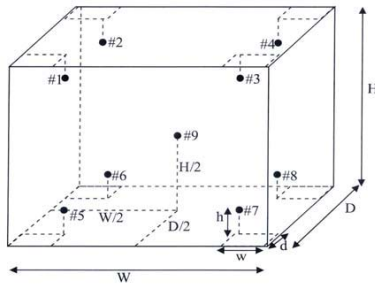
Authorized signatory

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DKSH Technology Limited
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CAL-FM-C31-10: 12 Sep 2022



Standard Installation Locations

Volume (Calibration Zone)= 369 (Liters)

Inside chamber: W = 100 (cm) D = 60 (cm) H = 120 (cm)

Standard Locations (#1, #2, #3, #4): w = 10 (cm) d = 6 (cm) h = 12 (cm)

Standard Locations (#5, #6, #7, #8): w = 10 (cm) d = 6 (cm) h = 12 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	201	202	203	204	205	206	207	208	209

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C31-10: 12 Sep 2022

Calibration Results:

Before adjustment

Setting: Indicating: #1: #2: #3: #4: #5: #6: #7: #8: #9:
20.0 20.0 20.07 20.00 20.28 20.07 20.37 20.39 20.65 20.41 20.21

After adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 20.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	20.03	0.03	0.23
#2	19.74	-0.26	0.23
#3	20.04	0.04	0.23
#4	19.83	-0.17	0.23
#5	20.04	0.04	0.23
#6	20.05	0.05	0.23
#7	20.33	0.33	0.23
#8	20.12	0.12	0.23
#9	19.90	-0.10	0.23

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
20.0	20.0	20.0	20.03	19.74	20.04	19.83	20.04	20.05	20.33	20.12	19.90	0.23

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
20.0	0.46	0.04	0.67

Note: * Maximum uncertainty of the each position

The End of Certificate

บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C31-10: 12 Sep 2022

HACH COMPANY

บริษัท แฮค คอมเมอร์เชียล (ประเทศไทย) จำกัด | อาคาร ซี ฟอยล์ที่ 3 ชั้นที่ 3 เลขที่ 7354 ถนนศรีนครินทร์ แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10250
C/O AB Solex (Thailand) Limited | Building D Room No. D3 11, 3rd Floor, No. 7354, Srinakarin Rd., Pattanakarn, Suanlung, Bangkok 10250
Phone: +66 (02) 026-3529 | Fax: +66(02) 026-3572 | www.sea.hach.com | Tax ID: 0105552107330

Ref No : LABX2302003

Certificate of Test Report

Customer	: THAI CHEMICAL & ENGINEERING CO.,LTD. (Color 2)		
Equipment	: Colorimeter	Manufacturer	: HACH
Controller Model	: ☐ DR890 ☒ DR900	Sensor Model	: -
Controller Serial No.	: 193150001062	Sensor Serial No.	: -
Date of Test	: 29 - AUG - 2023	Period	: 1 Yearly
Environment Temperature	: 25.4 °C	Humidity	: 51.2 %RH

Results

Item	Characteristic	Before	After	Remark
1	Visual Inspect	☒ Pass ☐ Fail	☒ Pass ☐ Fail	
2	Power Supply (4.5 - 6.5 VDC)	5.4 VDC	5.4 VDC	
3	Display Check	☒ Pass ☐ Fail	☒ Pass ☐ Fail	
4	Keyboard Check	☒ Pass ☐ Fail	☒ Pass ☐ Fail	
5	Fundon System Program	☒ Pass ☐ Fail	☒ Pass ☐ Fail	

Warning and Error Checked

Item	Event	Before	After
6	Error list	☒ None ☐ Appear	☒ None ☐ Appear

Calibration Results: Without Adjustment

Item	Wavelength	Standard absorbance (Abs)	Unit Under Calibration	Error	Remark
7	420 nm	0.625 ± 0.050	0.619	-0.006	
		1.220 ± 0.100	1.211	-0.009	
		1.764 ± 0.150	1.760	-0.004	
8	520 nm	0.625 ± 0.050	0.620	-0.005	
		1.230 ± 0.100	1.225	-0.005	
		1.783 ± 0.150	1.779	-0.004	
9	560 nm	0.641 ± 0.050	0.637	-0.004	
		1.250 ± 0.100	1.244	-0.006	
		1.830 ± 0.150	1.826	-0.004	
10	610 nm	0.614 ± 0.050	0.612	-0.002	
		1.191 ± 0.100	1.186	-0.005	
		1.730 ± 0.150	1.726	-0.004	

HACH COMPANY

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Phone: +66 (02) 026-3529 | Fax: +66(02) 026-3572 | www.sea.hach.com | Tax ID: 0105552107330

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Summary of checked

- ☒ The instrument can work normally and efficiently. (เครื่องมือวัดสามารถทำงานได้ปกติและมีประสิทธิภาพ)
- ☐ The instrument can work but it's requiring to maintenance. (เครื่องมือวัดสามารถทำงานได้แต่ต้องบำรุงรักษา)
- ☐ The instrument could not work it's requiring to repair. (เครื่องมือวัดไม่สามารถทำงานได้และต้องการซ่อมบำรุง)

Remark:

Reference of Standard and Equipment

Equipment	Equipment I.D.
DR/Check Absorbance Standard	Lot No. A2124 Exp. date : Jul-24
Digital Multi Meter	S/N : 28130132WS Due date : 07-Jul-24
Thermo Hygrometer	S/N : 41413945 Due date : 17-Aug-24

Test by :

(Mr.Chayaphon Wongwatt)

Senior Service Engineer

(Mr.Poolaph Kongsungsom)

Assistant Engineer & Project Division Manager