

**3.1 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้ว  
จากบ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ**

3.1.1 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ เมื่อเดือน  
กรกฎาคม 2566

3.1.2 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ เมื่อเดือน  
กันยายน 2566

3.1.3 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ เมื่อเดือน  
พฤศจิกายน 2566

3.1.4 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ เมื่อเดือน  
ธันวาคม 2566

**3.2 สำเนาต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการ  
วิเคราะห์เอกชน**

**3.3 สำเนาของ Certificate of Calibrate ของเครื่องมือ**

### 3.1 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้ว จากบ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ

3.1.1 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อบำบัดน้ำเสียสุดท้ายทางทิศใต้ของโครงการ  
เมื่อเดือนกรกฎาคม 2566



บริษัท วิศวกรรมเคมี จำกัด

THAI CHEMICAL & ENGINEERING CO., LTD.

1048/2 ซ.สุขุมวิท 66/1 อ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร 10260 โทร. 0-2744-9911 แฟกซ์ 0-2393-0165

1048/2 Soi Sukhumvit 66/1, Sukhumvit Rd., Prakanong Tai, Prakanong, Bangkok 10260 TEL. 0-2744-9911 FAX 0-2393-0165

No. 1603/66

### WASTE WATER ANALYSIS REPORT

Date : 11/07/66

Analysis Date : 05/07/66-10/07/66

Customer : โรงแรมพุทธรักษา ห้วยหิน

Sampling Date : 04/07/66

Address : เลขที่ 22/65 ถนนแบบเคหาสน์ ตำบลห้วยหิน อำเภอห้วยหิน จังหวัดประจวบคีรีขันธ์ 77110

Sampling Time : 14.00

Received Date : 05/07/66

Tel : 032-531-470

Reference Number	WP/PK 2958/66			
Parameter	Unit	น้ำเสียหลังบำบัด	มาตรฐาน อาคารประเภท จ.	Method of Analysis
Appearance		เหลืองขุ่น		
pH		@ 23.7 °C = 6.9	5-9	Electrometric (SM 2017.4500-H <sup>+</sup> B.)
Biochemical Oxygen Demand	(mg/l)	291	≤ 200	5-Day BOD Test, Azide Modification (SM 2017.5210 B.)
Total Suspended Solids	(mg/l)	96	≤ 60	Dried at 103-105°C (SM 2017.2540 D.)
Total Dissolved Solids	(mg/l)	370	-	Dried at 180°C (SM 2017.2540 C.)
Oil & Grease	(mg/l)	44.71	≤ 100	Soxhlet Extraction (SM 2017.5520 D.)
Total Kjeldahl Nitrogen	(mg/l)	34.63	-	Macro-Kjeldahl, Titrimetric (SM 2017.4500-N(org) B.)
Sulfide	(mg/l)	Not detected	-	ZnS Precipitation, Iodometric (SM 2017.4500-S <sup>2-</sup> F.)
Settleable Solids	(ml/l)	< 0.5	-	Imhoff Cone, Volumetric (SM 2017.2540 F.)

SM : Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 23 rd Edition, 2017.

จุดเก็บ : รีสอร์ท

- ❖ The results relate only to the samples tested and apply to customer's self-drawn samples only.
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Approved by





3.1.2 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ  
เมื่อเดือนกันยายน 2566



บริษัท วิศวกรรมเคมี จำกัด

THAI CHEMICAL & ENGINEERING CO., LTD.

1048/2 ซ.สุขุมวิท 66/1 ถ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร 10260 โทร. 0-2744-9911 แฟกซ์ 0-2393-0165

1048/2 Soi Sukhumvit 66/1, Sukhumvit Rd., Prakanong Tai, Prakanong, Bangkok 10260 TEL. 0-2744-9911 FAX 0-2393-0165

No. 2167/66

WASTE WATER ANALYSIS REPORT

Date : 12/09/66

Analysis Date : 06/09/66-11/09/66

Customer : โรงแรมพุทธรักษา ห้วยหิน

Sampling Date : 05/09/66

Address : เลขที่ 22/65 ถนนแนบเคหาสน์ ตำบลห้วยหิน อำเภอห้วยหิน จังหวัดประจวบคีรีขันธ์ 77110

Sampling Time : 11.00

Received Date : 06/09/66

Tel : 032-531-470

Reference Number	WP/PK 3968/66			
Parameter	Unit	น้ำเสียหลังบำบัด	มาตรฐาน อาคารประเภท จ.	Method of Analysis
Appearance		ขุ่นมีตะกอน		
pH		@ 24.6 °C = 6.3	5-9	Electrometric (SM 2017.4500-H <sup>+</sup> B.)
Biochemical Oxygen Demand	(mg/l)	381	≤ 200	5-Day BOD Test, Azide Modification (SM 2017.5210 B.)
Total Suspended Solids	(mg/l)	107	≤ 60	Dried at 103-105 °C (SM 2017.2540 D.)
Total Dissolved Solids	(mg/l)	507	-	Dried at 180 °C (SM 2017.2540 C.)
Oil & Grease	(mg/l)	64.76	≤ 100	Soxhlet Extraction (SM 2017.5520 D.)
Total Kjeldahl Nitrogen	(mg/l)	29.61	-	Macro-Kjeldahl, Titrimetric (SM 2017.4500-N(org) B.)
Sulfide	(mg/l)	1.20	-	ZnS Precipitation, Iodometric (SM 2017.4500-S <sup>2-</sup> F.)
Settleable Solids	(ml/l)	< 0.5	-	Imhoff Cone, Volumetric (SM 2017.2540 F.)

SM : Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 23 rd Edition, 2017.

จุดเก็บ : รีสอร์ท

❖ The results relate only to the samples tested and apply to customer's self-drawn samples only.

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Approved by



**3.1.3 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อกักน้ำสุดท้ายทางทิศใต้ของโครงการ  
เมื่อเดือนพฤศจิกายน 2566**



บริษัท วิศวกรรมเคมี จำกัด

THAI CHEMICAL & ENGINEERING CO., LTD.

1048/2 ซ.สุขุมวิท 66/1 อ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพฯ 10260 โทร. 0-2744-9911 แฟกซ์ 0-2393-0165

1048/2 Soi Sukhumvit 66/1, Sukhumvit Rd., Prakanong Tai, Prakanong, Bangkok 10260 TEL. 0-2744-9911 FAX 0-2393-0165

No. 2679/66

### WASTE WATER ANALYSIS REPORT

Date : 14/11/66

Analysis Date : 07/11/66-13/11/66

Customer : โรงแรมพุทธรักษา ห้วยหิน

Sampling Date : 06/11/66

Address : เลขที่ 22/65 ถนนแนบเคหาสน์ ตำบลห้วยหิน อำเภอห้วยหิน จังหวัดประจวบคีรีขันธ์ 77110

Sampling Time : 11.30

Received Date : 07/11/66

Tel : 032-531-470

Reference Number	WP/PK 4933/66			
Parameter	Unit	น้ำเสียหลังบำบัด	มาตรฐาน อาคารประเภท จ.	Method of Analysis
Appearance		เหลืองใสมีตะกอน		
pH		@ 23.7 °C = 7.3	5-9	Electrometric (SM 2017:4500-H <sup>+</sup> B.)
Biochemical Oxygen Demand	(mg/l)	12	≤ 200	5-Day BOD Test, Azide Modification (SM 2017:5210 B.)
Total Suspended Solids	(mg/l)	24	≤ 60	Dried at 103-105 °C (SM 2017:2540 D.)
Total Dissolved Solids	(mg/l)	292	-	Dried at 180 °C (SM 2017:2540 C.)
Oil & Grease	(mg/l)	< 5.00	≤ 100	Soxhlet Extraction (SM 2017:5520 D.)
Total Kjeldahl Nitrogen	(mg/l)	8.37	-	Macro-Kjeldahl, Titrimetric (SM 2017:4500-N(org) B.)
Sulfide	(mg/l)	Not detected	-	ZnS Precipitation, Iodometric (SM 2017:4500-S <sup>2-</sup> F.)
Settleable Solids	(ml/l)	< 0.5	-	Imhoff Cone, Volumetric (SM 2017:2540 F.)

SM : Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 23 rd Edition, 2017.

จุดเก็บ : รีสอร์ท

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Approved by



3.1.4 ผลตรวจวัดคุณภาพน้ำหลังบำบัดน้ำเสียแล้วจาก  
บ่อบำบัดน้ำเสียสุดท้ายทางทิศใต้ของโครงการ  
เมื่อเดือนธันวาคม 2566





บริษัท วิศวกรรมเคมี จำกัด

THAI CHEMICAL & ENGINEERING CO., LTD.

1048/2 ซ.สุขุมวิท 66/1 ถ.สุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร 10260 โทร. 0-2744-9911 แฟกซ์ 0-2393-0165

1048/2 Soi Sukhumvit 66/1, Sukhumvit Rd., Prakanong Tai, Prakanong, Bangkok 10260 TEL: 0-2744-9911 FAX: 0-2393-0165

No. 3155/66

### WASTE WATER ANALYSIS REPORT

Date : 02/01/67

Analysis Date : 22/12/66-28/12/66

Customer : โรงแรมพุทธรักษา ห้วยหิน

Sampling Date : 21/12/66

Address : เลขที่ 22/65 ถนนแนบเคหาสน์ ตำบลห้วยหิน อำเภอห้วยหิน จังหวัดประจวบคีรีขันธ์ 77110

Sampling Time : 13.30

Received Date : 22/12/66

Tel : 032-531-470

Reference Number	WP/PK 5799/66			Method of Analysis
Parameter	Unit	น้ำเสียหลังบำบัด	มาตรฐาน อาคารประเภท จ.	
Appearance		ขุ่น		
pH		@ 24.5 °C = 6.9	5-9	Electrometric (SM 2017:4500-H <sup>+</sup> B.)
Biochemical Oxygen Demand	(mg/l)	253	≤ 200	5-Day BOD Test, Azide Modification (SM 2017:5210 B.)
Total Suspended Solids	(mg/l)	128	≤ 60	Dried at 103-105 °C (SM 2017:2540 D.)
Total Dissolved Solids	(mg/l)	410	-	Dried at 180 °C (SM 2017:2540 C.)
Oil & Grease	(mg/l)	20.68	≤ 100	Soxhlet Extraction (SM 2017:5520 D.)
Total Kjeldahl Nitrogen	(mg/l)	36.81	-	Macro-Kjeldahl, Titrimetric (SM 2017:4500-N(org) B.)
Sulfide	(mg/l)	1.40	-	ZnS Precipitation, Iodometric (SM 2017:4500-S <sup>2-</sup> F.)
Settleable Solids	(ml/l)	< 0.5	-	Imhoff Cone, Volumetric (SM 2017:2540 F.)

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### 3.2 สำเนาต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการ วิเคราะห์เอกชน



ที่ อก ๐๓๑๐(๑)/ ๕๕๓ ๓

กรมโรงงานอุตสาหกรรม  
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท  
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๙ พฤษภาคม ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท วิศวกรรมเคมี จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน  
ลงวันที่ ๒ มีนาคม ๒๕๖๕

สิ่งที่ส่งมาด้วย เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
บริษัท วิศวกรรมเคมี จำกัด จำนวน ๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท วิศวกรรมเคมี จำกัด ขอต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๐๐๑ สถานที่ตั้งเลขที่ ๑๐๔๘/๒ ซอยสุขุมวิท ๖๖/๑ ถนนสุขุมวิท แขวงพระโขนงใต้ เขตพระโขนง กรุงเทพมหานคร ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท วิศวกรรมเคมี จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์

๑) นางสาวธัญญรัตน์ พลอยกระจำ

ทะเบียนเลขที่ ว-๐๐๑-ค-๐๐๐๑

๒) นางสาวกรรณตนา สว่างรุ่งรัตน์

ทะเบียนเลขที่ ว-๐๐๑-ค-๐๐๐๒

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์

๑) นางสาวรัชนิษฐ์ วนิชกุลวิริยะ

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๑

๒) นางสาวกมลชนก วงศ์พนาไกร

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๒

๓) นางสาววรลักษณ์ เทียนกระจำ

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๓

๔) นางสาวเกวรินทร์ ศิริวัฒนสกุล

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๔

๕) นางสาวจิราพร เบญจจริยาภรณ์

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๕

๖) นางสาวจรรวรณ์ ต้นสกุล

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๖

๗) นางสาวกาญจนา ลาชุมเหล็ก

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๗

๘) นางสาวกิตติยา นารี

ทะเบียนเลขที่ ว-๐๐๑-จ-๐๐๐๘

ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย ตามสิ่งที่ส่งมาด้วย

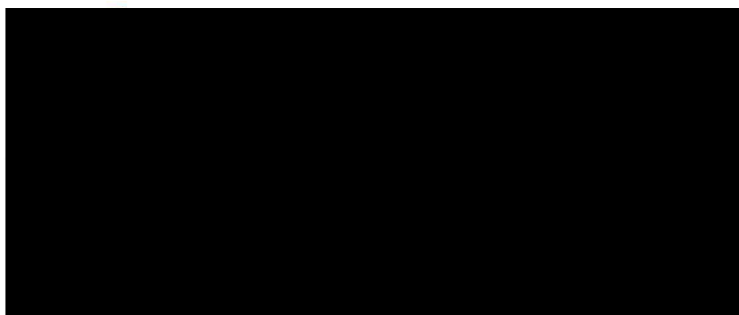
หนังสือฉบับนี้...



หนังสือฉบับนี้จะหมดอายุในวันที่ ๘ เมษายน ๒๕๖๘ หากประสงค์จะต่ออายุหนังสือ  
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอ  
ต่อกรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์  
เอกชน ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code  
ท้ายหนังสือฉบับนี้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ



กองวิจัยและเตือนภัยมลพิษโรงงาน  
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ  
โทร. ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๐๓-๕  
โทรสาร ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๙๙  
ไปรษณีย์อิเล็กทรอนิกส์ saraban@diw.mail.go.th

ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์



เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท วิศวกรรมเคมี จำกัด

เลขทะเบียน ว-๐๐๑

ที่ อก ๐๓๑๐(๑)/ ๕๕๓ ๓

ลงวันที่ ๙ พฤษภาคม ๒๕๖๕

ขอขยายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๒๐ รายการ

น้ำเสีย จำนวน 20 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Arsenic	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
2	Barium	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
3	Biochemical Oxygen Demand	5-Day BOD Test, Azide Modification Method <sup>[2]</sup>
4	Cadmium	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
5	Chemical Oxygen Demand	1) Closed Reflux, Colorimetric Method <sup>[2]</sup> 2) Closed Reflux, Titrimetric Method <sup>[2]</sup>
6	Chromium	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
7	Color	ADMI Weighted-Ordinate Spectrophotometric Method <sup>[2]</sup>
8	Copper	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
9	Formaldehyde	Distillation, Colorimetric Method <sup>[1]</sup>
10	Lead	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
11	Manganese	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
12	Nickel	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
13	Oil & Grease	Soxhlet Extraction Method <sup>[2]</sup>
14	pH	Electrometric Method <sup>[2]</sup>
15	Selenium	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>
16	Sulfide	Iodometric Method <sup>[2]</sup>
17	Total Dissolved Solids	Dried at 180 °C <sup>[2]</sup>
18	Total Kjeldahl Nitrogen	Macro Kjeldahl Method <sup>[2]</sup>
19	Total Suspended Solids	Dried at 103-105 °C <sup>[2]</sup>
20	Zinc	Digestion, Inductively Coupled Plasma Method <sup>[2]</sup>

#### เอกสารอ้างอิง

1. สมาคมวิศวกรรมสิ่งแวดล้อมแห่งประเทศไทย. คู่มือวิเคราะห์น้ำเสีย. พิมพ์ครั้งที่ 4. กรุงเทพฯ: เรือนแก้วการพิมพ์, 2547.

2. APHA, AWWA, WEF. Standard Methods for the Examination of Water and Wastewater. 23<sup>rd</sup> ed. Washington, DC: APHA, 2017.



### 3.3 สำเนาของ Certificate of Calibrate ของเครื่องมือ



## Certificate of Calibration

<b>Equipment:</b>	pH METER	<b>Certificate No.:</b>	C07220529
<b>Model:</b>	HM-41X	<b>Issued Date:</b>	9 November 2022
<b>Serial No. (or ID.):</b>	890323 (INS/LB 159)	<b>Job No.:</b>	KSPR2212886
<b>Manufacturer:</b>	TOA-DKK	<b>Page:</b>	1 of 4
<b>Electrode Serial No.:</b>	007F0040MK	<b>Model:</b>	GST-5821C
<b>Condition:</b>	In Condition	<b>Brand:</b>	TOA-DKK

**Customer:** THAI CHEMICAL & ENGINEERING CO., LTD.  
1048/2 Soi Sukhumvit 66/1, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260 Thailand

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

**Calibration Place:** Environment Laboratory, DKSH Technology Limited.  
1194 Soi Wachirathamsathit 57, Sukhumvit 101/1 Rd.,  
Bangchak, Phrakhanong, Bangkok 10260 Thailand

**Calibration By:** Mr.Piyapat Saidoung

**Calibration Date:** 15 October 2022

**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. 794132, 794134, 794133 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20210028EA

Person in charge

Authorized signatory

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

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

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

## Calibration Results:

### pH Scale

Input	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	Error (mV)	(pH)		
414.12	414	-0.12	0.001	0.58	2.00
354.96	355	0.04	1.001	0.58	2.00
295.8	296	0.20	2.000	0.58	2.00
236.64	237	0.36	3.001	0.58	2.00
177.48	177	-0.48	4.001	0.58	2.00
118.32	118	-0.32	5.001	0.58	2.00
59.16	59	-0.16	6.001	0.58	2.00
0	0	0.00	7.000	0.58	2.00
-59.16	-59	0.16	8.000	0.58	2.00
-118.32	-118	0.32	9.000	0.58	2.00
-177.48	-177	0.48	10.000	0.58	2.00
-236.64	-237	-0.36	11.000	0.58	2.00
-295.8	-296	-0.20	12.000	0.58	2.00
-354.96	-355	-0.04	13.000	0.58	2.00
-414.12	-414	0.12	14.000	0.58	2.00

### Electrode Test Results\*

The two-point calibration using two standard buffer solutions; pH 4.010 and pH 6.985

- During calibration, display of pH meter can be adjust to reading; pH 4.010 and pH 6.985

The practical slope of the pH electrode; 58.62 (mV/pH), 99.09%

The zero point of the pH electrode; 6.91 (pH)

### Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	4.011	0.003	0.0070	2.00
6.985	6.979	-0.006	0.0075	2.00
10.015	9.976	-0.039	0.0070	2.00

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

**Electrode Test Results\***

The two-point calibration using two standard buffer solutions; pH 6.985 and pH 10.015

- During calibration, display of pH meter can be adjust to reading; pH 6.985 and pH 10.015

The practical slope of the pH electrode; 57.90 (mV/pH), 97.88%

The zero point of the pH electrode; 6.90 (pH)

**Sample Test Results**

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	3.969	-0.039	0.0070	2.03
6.985	6.984	-0.001	0.0075	2.00
10.015	10.006	-0.009	0.0070	2.00

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

**The End of Certificate**





# Certificate of Calibration

<b>Equipment:</b>	Digital Thermometer	<b>Certificate No.:</b> C15220514
<b>Model:</b>	HM-41X	<b>Issued Date:</b> 09 November 2022
<b>Serial No.(or ID):</b>	890323 (INS/LB 159)	<b>Job No.:</b> KSPR2212885
<b>Manufacturer:</b>	TOA-DKK	<b>Page:</b> 1 of 2
<b>Condition:</b>	In Condition	

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

**Environment Condition:** Temperature: 22 °C ± 3.0 °C  
Humidity: 50 %RH ± 15.0 %RH  
Voltage: 230 VAC ± 11.0 VAC

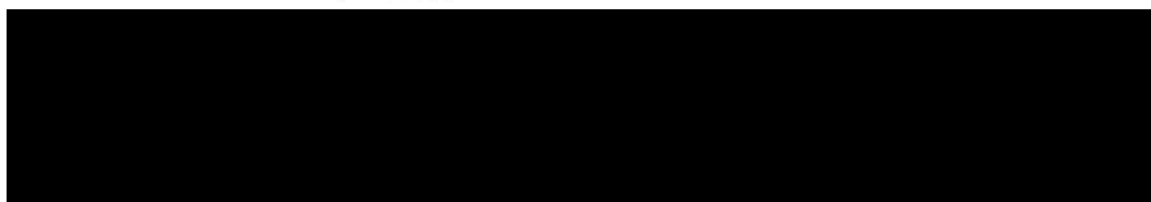
**Calibration Place:** Sensor Laboratory, DKSH Technology Limited.  
1194 Soi Wachirathamsathit 57, Sukhumvit 101/1 Rd.,  
Bangchak, Prakanong, Bangkok 10260 Thailand

**Calibration By:** Mr. Anat Karapitak

**Calibration Date:** 12 October 2022

**The Method used:** In house method, CAL-WI-19, by comparison with standard thermometer

**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Quality Reborn Co.,Ltd. (QR) Certificate No. QR22-0366



Person in charge

Authorized signatory

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

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

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

**Calibration Results:****Without Adjustment**

Sensor Type: Thermistor

Channel: -

Diameter (mm) 12

Length (mm): 130

Immersion (mm): 110

Desired Temp.(°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)	Uncertainty (± °C)
20.0	20.002	19.9	0.102	0.071
25.0	25.017	25.0	0.017	0.071
30.0	30.018	30.0	0.018	0.071

**The End of Certificate**



## Certificate of Calibration

Equipment:	Balance	Certificate No.:	C01222664
Model:	BSA3202S-CW	Issued Date:	05 September 2022
Serial No. (or ID.):	28591190 (INS/LB-113)	Job No.:	KSPR2210852
Manufacturer:	Sartorius	Page:	1 of 2
Condition:	In condition		

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

**Environment Condition:** Temperature 25 °C ± 0.4 °C  
Humidity 54 %RH ± 2.7 %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 Ruamirup

**Calibration Date:** 05 September 2022

**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 SPC RT Co., Ltd. Certificate No. C02221060

Person in charge

Authorized signatory

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

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

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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

W.3.3-7

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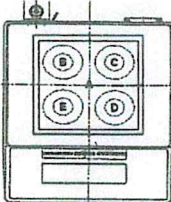
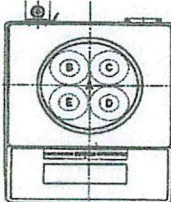
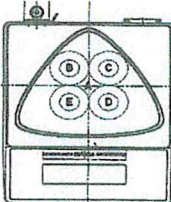
CAL-FM-C01-13: 20 Jul 2022



## 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	1000	(g)
Reference Points (g)					
A	B	C	D	E	
-	0.00	0.00	-0.01	0.00	

**Repeatability:** Determination of the standard deviation of weighing balance., Readability 0.01 (g)

Nominal test value (g)	Standard Deviation
200	0.000
2000	0.004

**Error of indication from nominal or conventional mass value.,** Readability 0.01 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.000	1.00	0.00	0.0096	2.02
10	10.000	10.00	0.00	0.0096	2.02
50	50.000	50.00	0.00	0.0096	2.02
100	100.000	100.00	0.00	0.0096	2.02
200	200.000	200.00	0.00	0.0096	2.02
500	500.000	500.00	0.00	0.0097	2.02
1000	1000.000	1000.00	0.00	0.010	2.02
1500	1500.000	1500.00	0.00	0.010	2.01
2000	2000.000	2000.00	0.00	0.011	2.01
2500	2500.000	2500.00	0.00	0.012	2.01
3000	3000.001	3000.00	0.00	0.012	2.01

The End of Certificate



## Certificate of Calibration

Equipment:	Balance	Certificate No.:	C01222667
Model:	BSA224S-CW	Issued Date:	05 September 2022
Serial No. (or ID.):	3137910058 (INS/LB-144)	Job No.:	KSPR2210855
Manufacturer:	Sartorius	Page:	1 of 2
Condition:	In condition		

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

**Environment Condition:** Temperature 25 °C  $\pm$  0.3 °C  
Humidity 54 %RH  $\pm$  2.8 %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 Ruamlrup

**Calibration Date:** 05 September 2022

**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 SPC RT Co., Ltd. Certificate No. C02212684

Person in charge

Authorized signatory

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

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

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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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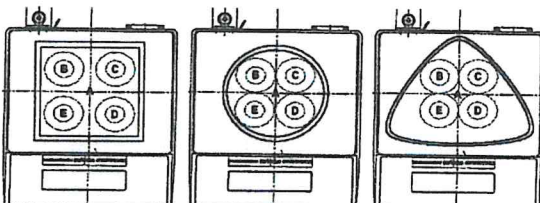
CAL-FM-C01-13: 20 Jul 2022



## 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
-		0.0001		0.0000		-0.0002
						0.0001

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

Nominal test value (g)	Standard Deviation
20	0.00005
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	2.05
2	2.00001	2.0000	0.0000	0.00011	2.05
5	5.00000	5.0000	0.0000	0.00012	2.05
10	9.99998	10.0000	0.0000	0.00012	2.05
20	20.00001	20.0000	0.0000	0.00012	2.04
50	49.99997	50.0000	0.0000	0.00013	2.03
100	99.99996	100.0001	0.0001	0.00018	2.01
120	119.99997	120.0000	0.0000	0.00021	2.00
150	149.99993	149.9999	0.0000	0.00024	2.00
200	199.99999	200.0001	0.0001	0.00030	2.00

**The End of Certificate**

**Statements of conformity:**

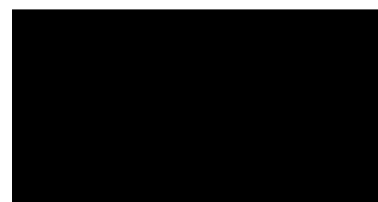
This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, UKAS Lab14. Therefore, those parameters have not been assessed separately.

**Tolerance and Decision rules:**

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :**
- ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w = 0$ ), Specific Risk  $< 50\%$  PFA
  - ☒ Choice B Non-binary statement with guard band ( $w = 1 U$ ), Specific Risk  $< 2.5\%$  PFA
  - ☐ Choice C Customer defined, Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w = r U$ ) .  
; PFA – Probability of False Accept



Authorized signatory

## Statements of conformity:

### Without Adjustment

Readability: 0.0001 g

Tolerances : 0.0005 g

Nominal Value g	Error of indication g	Guard band (w) g	Tolerance ( $\pm$ ) g	Conformity
1	0.0000	0.00011	0.0005	Pass
2	0.0000	0.00011	0.0005	Pass
5	0.0000	0.00012	0.0005	Pass
10	0.0000	0.00012	0.0005	Pass
20	0.0000	0.00012	0.0005	Pass
50	0.0000	0.00013	0.0005	Pass
100	0.0001	0.00018	0.0005	Pass
120	0.0000	0.00021	0.0005	Pass
150	0.0000	0.00024	0.0005	Pass
200	0.0001	0.00030	0.0005	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

**The End of Statements of conformity**



# Certificate of Calibration

<b>Equipment:</b>	Hot Air Oven	<b>Certificate No.:</b>	C31221688
<b>Model:</b>	UF55	<b>Issued Date:</b>	06 September 2022
<b>Serial No.(or ID):</b>	B218.3817 ( INS/LB-134 )	<b>Job No.:</b>	KSPR2210856
<b>Manufacturer:</b>	Memmert	<b>Page:</b>	1 of 4
<b>Condition:</b>	In Condition	<b>Ventilation Valve:</b>	Closed
<b>Shelves(pc.):</b>	2		

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

**Environment Condition:**

Temperature:	23 °C	±	1.5 °C
Humidity:	63 %RH	±	6.1 %RH
Voltage:	226 VAC	±	1.2 VAC

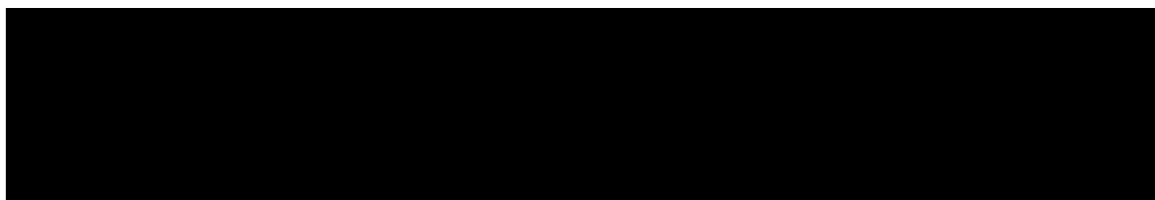
**Calibration Place:** THAI CHEMICAL & ENGINEERING CO., LTD. ( Laboratory )  
1048/2 Sukhumvit 66/1 Rd., Prakanong Tai,  
Prakanong, Bangkok 10260 Thailand

**Calibration By:** Mr. Jetsada Poonaklom

**Calibration Date:** 05 September 2022

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

**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C10220006



Person in charge

Authorized signatory

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

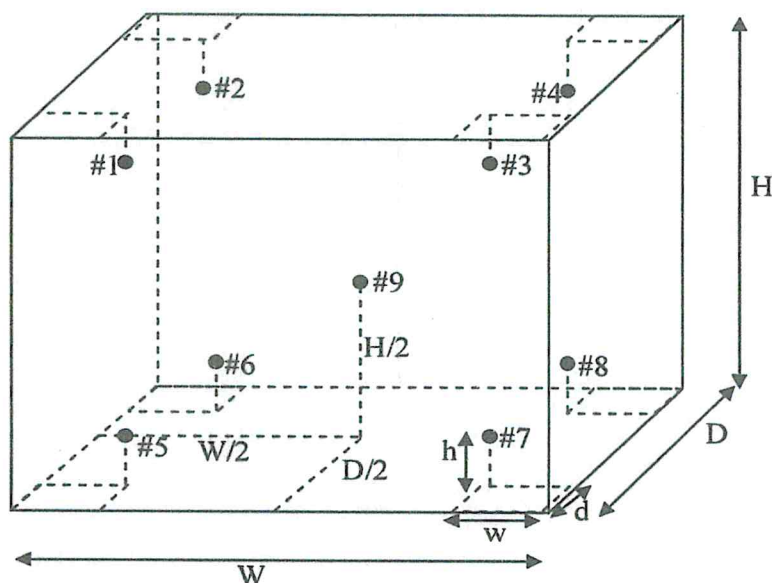
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

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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

PL3.3-13





### Standard Installation Locations

Volume (Calibration Zone)= 16 (Liters)

Inside chamber:  $W = 40 \text{ (cm)}$   $D = 33 \text{ (cm)}$   $H = 40 \text{ (cm)}$

Standard Locations (#1, #2, #3, #4):  $w = 5 \text{ (cm)}$   $d = 5 \text{ (cm)}$   $h = 5 \text{ (cm)}$

Standard Locations (#5, #6, #7, #8):  $w = 5 \text{ (cm)}$   $d = 5 \text{ (cm)}$   $h = 12 \text{ (cm)}$

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	1	2	3	4	5	6	7	8	9

### 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.

**Calibration Results:**
**Before adjustment**

Setting:            Indicating:    #1:    #2:    #3:    #4:    #5:    #6:    #7:    #8:    #9:  
 180.0                180.0        179.50 178.46 180.12 178.90 180.18 179.13 180.21 178.89 179.60

**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	103.94	-0.06	0.39
#2	103.56	-0.44	0.39
#3	104.18	0.18	0.39
#4	103.67	-0.33	0.39
#5	104.26	0.26	0.39
#6	103.75	-0.25	0.39
#7	103.83	-0.17	0.43
#8	103.57	-0.43	0.39
#9	103.96	-0.04	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	103.94	103.56	104.18	103.67	104.26	103.75	103.83	103.57	103.96	0.43

**Chamber Characterization**

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104.0	0.46	0.23	1.09

Note: \* Maximum uncertainty of the each position



**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	180.00	0.00	0.42
#2	178.95	-1.05	0.42
#3	180.60	0.60	0.42
#4	179.44	-0.56	0.42
#5	180.69	0.69	0.42
#6	179.62	-0.38	0.42
#7	180.72	0.72	0.44
#8	179.42	-0.58	0.42
#9	180.07	0.07	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	180.00	178.95	180.60	179.44	180.69	179.62	180.72	179.42	180.07	0.44

**Chamber Characterization**

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180.0	1.17	0.12	1.93

Note: \* Maximum uncertainty of the each position

**The End of Certificate**



# Certificate of Calibration

<b>Equipment:</b>	Hot Air Oven	<b>Certificate No.:</b>	C31222118
<b>Model:</b>	UF 55	<b>Issued Date:</b>	07 November 2022
<b>Serial No.(or ID):</b>	B219.1995 ( INS/LB 149 )	<b>Job No.:</b>	KSPR2212876
<b>Manufacturer:</b>	Memmert	<b>Page:</b>	1 of 4
<b>Condition:</b>	In Condition	<b>Ventilation Valve:</b>	Closed
<b>Shelves(pc.):</b>	2		

**Customer:** THAI CHEMICAL & ENGINEERING CO., LTD.  
1048/2 Soi Sukhumvit 66/1, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260 Thailand

**Environment Condition:**

Temperature:	25 °C	±	1.0 °C
Humidity:	55 %RH	±	4.7 %RH
Voltage:	224 VAC	±	2.2 VAC

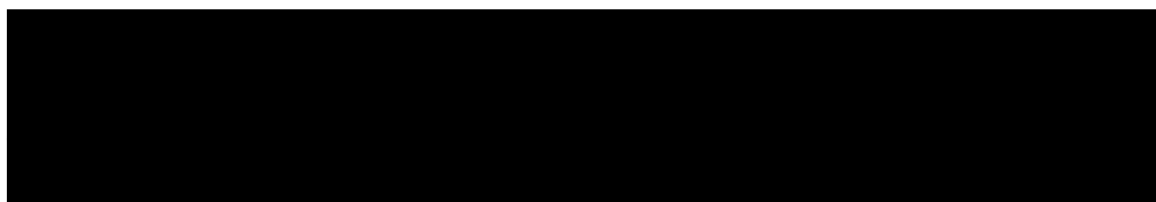
**Calibration Place:** THAI CHEMICAL & ENGINEERING CO., LTD. ( Laboratory )  
1048/2 Soi Sukhumvit 66/1, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260 Thailand

**Calibration By:** Mr. Preecha Phooarsai

**Calibration Date:** 07 November 2022

**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 SPC RT Co., Ltd. Certificate No. C10220006



Person in charge

Authorized signatory

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

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

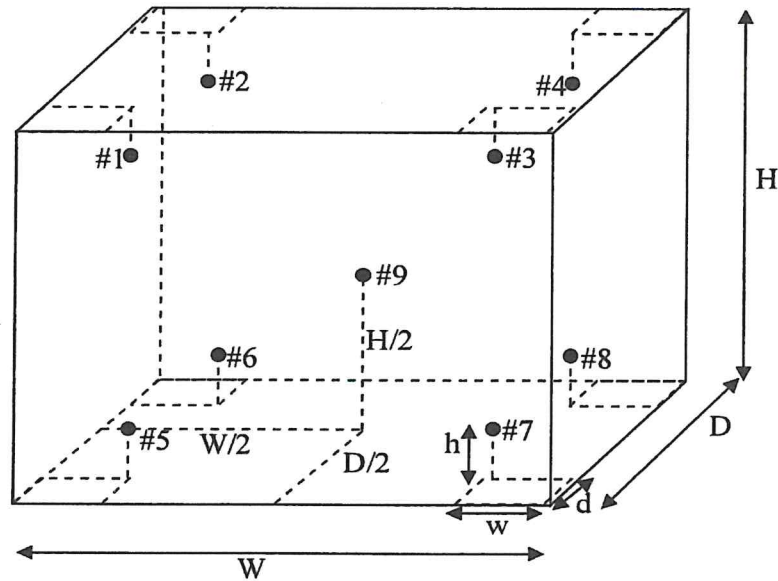
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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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-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	1	2	3	4	5	6	7	8	9

### 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.



## Calibration Results:

### Without 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	103.50	-0.50	0.39
#2	103.74	-0.26	0.39
#3	104.29	0.29	0.39
#4	103.91	-0.09	0.39
#5	104.20	0.20	0.39
#6	103.77	-0.23	0.39
#7	103.57	-0.43	0.39
#8	104.24	0.24	0.39
#9	104.31	0.31	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	103.50	103.74	104.29	103.91	104.20	103.77	103.57	104.24	104.31	0.39

### Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104.0	0.86	0.08	0.92

Note: \* Maximum uncertainty of the each position

**Without 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	180.65	0.65	0.43
#2	179.51	-0.49	0.42
#3	181.22	1.22	0.42
#4	180.17	0.17	0.42
#5	179.95	-0.05	0.42
#6	179.53	-0.47	0.43
#7	179.49	-0.51	0.49
#8	180.19	0.19	0.44
#9	180.53	0.53	0.43

**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	180.65	179.51	181.22	180.17	179.95	179.53	179.49	180.19	180.53	0.49

**Chamber Characterization**

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180.0	1.25	0.22	1.99

Note: \* Maximum uncertainty of the each position

**The End of Certificate**

## Statements of conformity:

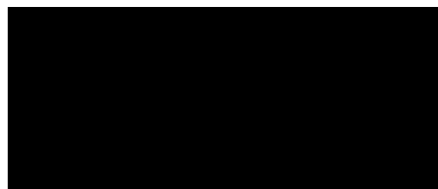
This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The correction of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, TLAS-G20. Therefore, those parameters have not been assessed separately.

### Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :** ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w = 0$ ), Specific Risk < 50% PFA.
- ☒ Choice B Non-binary statement with guard band ( $w = 1$  U), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.
- ☐ Choice C Customer defined, Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w = r$  U) .  
; PFA – Probability of False Accept



Authorized signatory

## Without adjustment

Desired Temperature : 104.0°C Tolerances : 1.0 °C

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

Locations	Measured (°C)	Correction of UUC. (°C)	Guard band (W) (± °C)	Tolerance (± °C)	Conformity
#1	103.50	-0.50	0.39	1.0	Pass
#2	103.74	-0.26	0.39	1.0	Pass
#3	104.29	0.29	0.39	1.0	Pass
#4	103.91	-0.09	0.39	1.0	Pass
#5	104.20	0.20	0.39	1.0	Pass
#6	103.77	-0.23	0.39	1.0	Pass
#7	103.57	-0.43	0.39	1.0	Pass
#8	104.24	0.24	0.39	1.0	Pass
#9	104.31	0.31	0.39	1.0	Pass

Correction of UUC.\* = Measured Temperature - Desired Temperature

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.



**Statements of conformity:(Cont.)****Without adjustment (Cont.)**

Desired Temperature : 180.0°C Tolerances : 2.0 °C

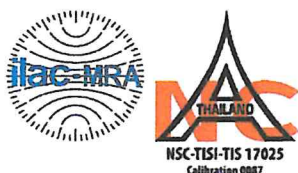
Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 180.0 °C

Locations	Measured (°C)	Correction of UUC.* (°C)	Guard band (W) (± °C)	Tolerance (± °C)	Conformity
#1	180.65	0.65	0.43	2.0	Pass
#2	179.51	-0.49	0.42	2.0	Pass
#3	181.22	1.22	0.42	2.0	Pass
#4	180.17	0.17	0.42	2.0	Pass
#5	179.95	-0.05	0.42	2.0	Pass
#6	179.53	-0.47	0.43	2.0	Pass
#7	179.49	-0.51	0.49	2.0	Pass
#8	180.19	0.19	0.44	2.0	Pass
#9	180.53	0.53	0.43	2.0	Pass

Correction of UUC.\* = Measured Temperature - Desired Temperature

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

**The End of Statements of Conformity**



## Certificate of Calibration

<b>Equipment:</b>	Liquid Bath	<b>Certificate No.:</b>	C13230090
<b>Model:</b>	WNE 14	<b>Issued Date:</b>	09 March 2023
<b>Serial No. (or ID.):</b>	L417.0480 ( INS/LB-130 )	<b>Job No.:</b>	KSPR2302517
<b>Manufacturer:</b>	Memmert	<b>Page:</b>	1 of 3
<b>Condition:</b>	In Condition		
<b>Forced Circulation:</b>	None		

**Customer:** THAI CHEMICAL & ENGINEERING CO., LTD.  
1048/2 Soi Sukhumvit 66/1, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260 Thailand

**Environment Condition:** Temperature: 23 °C ± 0.8 °C  
Humidity: 47 %RH ± 2.4 %RH  
Voltage: 225 VAC ± 1.3 VAC

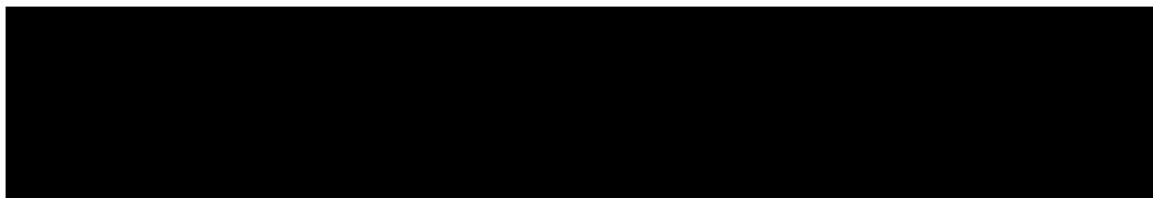
**Calibration Place:** THAI CHEMICAL & ENGINEERING CO., LTD. ( Laboratory )  
1048/2 Soi Sukhumvit 66/1, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260 Thailand

**Calibration By:** Mr. Thanakrit Raksapol

**Calibration Date:** 03 March 2023

**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 SPC RT Co., Ltd. Certificate No. C10220009



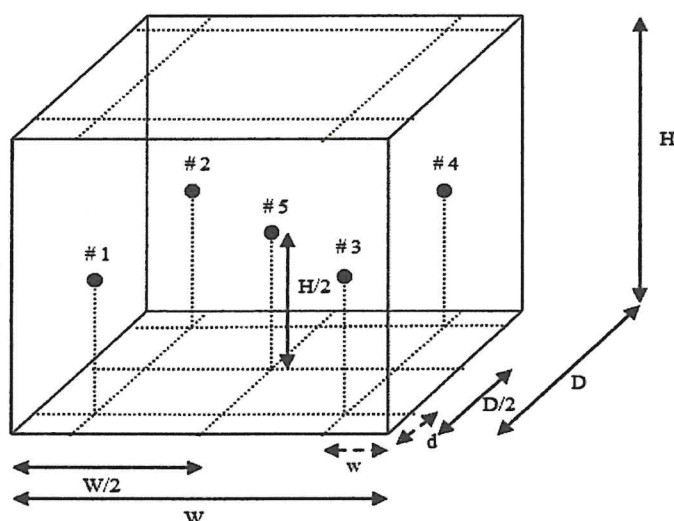
Person in charge

Authorized signatory

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

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

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



### 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	1	2	3	4	5

### 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.

## Calibration Results:

### Without adjustment

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	0.25
#2	85.04	0.04	0.26
#3	85.03	0.03	0.29
#4	85.05	0.05	0.19
#5	85.02	0.02	0.19

### 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	85.04	85.03	85.05	85.02	0.29

### Bath Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
85.0	0.29	0.12	0.41

Note: \* Maximum uncertainty of the each position

**The End of Certificate**



## Statements of conformity:

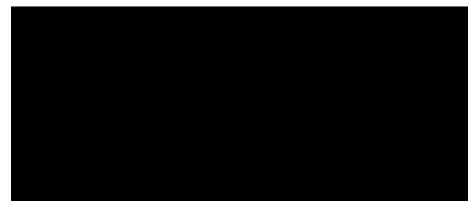
This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The correction of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, ASTM E715-80. Therefore, those parameters have not been assessed separately.

### Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :** ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w = 0$ ), Specific Risk < 50% PFA.
- ☒ Choice B Non-binary statement with guard band ( $w = 1$  U), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.
- ☐ Choice C Customer defined, Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w = r$  U) .
- ; PFA – Probability of False Accept



Authorized signatory

### Without adjustment

Desired Temperature : 85.0 °C Tolerances : 1.0 °C

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

Locations	Measured (°C)	Correction of UUC. (°C)	Guard band (W) (± °C)	Tolerance (± °C)	Conformity
#1	84.86	-0.14	0.25	1.0	Pass
#2	85.04	0.04	0.26	1.0	Pass
#3	85.03	0.03	0.29	1.0	Pass
#4	85.05	0.05	0.19	1.0	Pass
#5	85.02	0.02	0.19	1.0	Pass

Correction of UUC.\* = Measured Temperature - Desired Temperature

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

### The End of Statements of Conformity



# Certificate of Calibration

<b>Equipment:</b>	Incubator	<b>Certificate No.:</b>	C31221699
<b>Model:</b>	IN 55	<b>Issued Date:</b>	07 September 2022
<b>Serial No.(or ID):</b>	D212.0259 ( INS/LB-017 )	<b>Job No.:</b>	KSPR2210858
<b>Manufacturer:</b>	Memmert	<b>Page:</b>	1 of 3
<b>Condition:</b>	In Condition	<b>Ventilation Valve:</b>	Closed
<b>Shelves(pc.):</b>	1		

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

**Environment Condition:**

Temperature:	24 °C	±	0.9 °C
Humidity:	56 %RH	±	6.8 %RH
Voltage:	228 VAC	±	4.5 VAC

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

**Calibration By:** Mr. Tharanid Fasawang

**Calibration Date:** 05 September 2022

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

**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C10220002

Person in charge

Authorized signatory

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

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

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

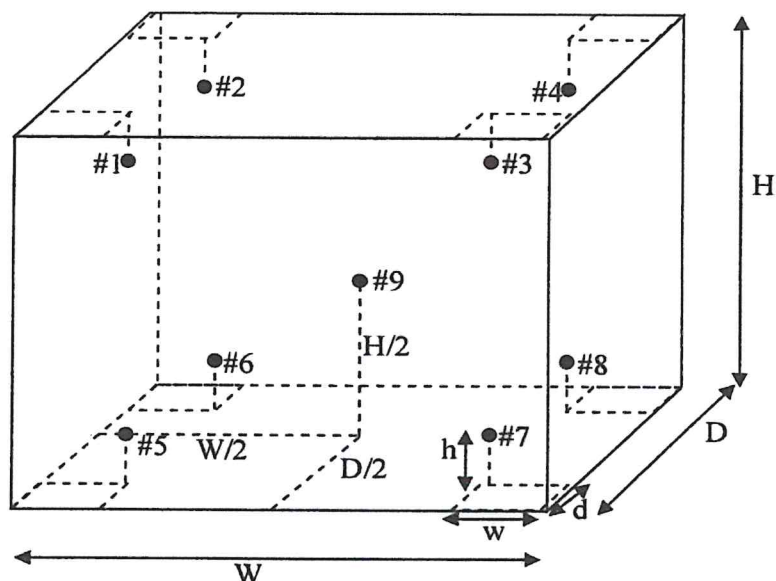
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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
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CAL-FM-C31-09: 20 Jul 2022





### 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	1	2	3	4	5	6	7	8	9

### 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.

**Calibration Results:**
**Without adjustment**

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

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	35.17	0.17	0.30
#2	35.19	0.19	0.24
#3	35.18	0.18	0.23
#4	35.21	0.21	0.23
#5	34.80	-0.20	0.23
#6	35.08	0.08	0.32
#7	35.40	0.40	0.25
#8	34.88	-0.12	0.24
#9	35.16	0.16	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	35.17	35.19	35.18	35.21	34.80	35.08	35.40	34.88	35.16	0.32

**Chamber Characterization**

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
35.0	0.43	0.21	0.75

Note: \* Maximum uncertainty of the each position

**The End of Certificate**

## Statements of conformity:

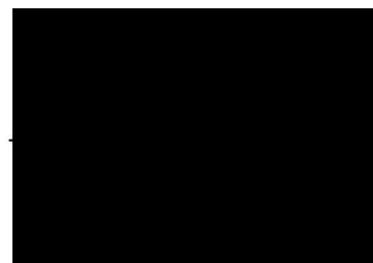
This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The correction of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, TLAS-G20. Therefore, those parameters have not been assessed separately.

### Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :**
- ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w = 0$ ), Specific Risk  $< 50\%$  PFA
  - ☒ Choice B Non-binary statement with guard band ( $w = 1 U$ ), Specific Risk  $< 2.5\%$  PFA
  - ☐ Choice C Customer defined, Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w = r U$ ).  
; PFA – Probability of False Accept



### Without adjustment

Desired Temperature : 35.0 °C Tolerances : 1.0 °C

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

Locations	Measured (°C)	Correction of UUC. (°C)	Guard band (W) (± °C)	Tolerance (± °C)	Conformity
#1	35.17	0.17	0.3	1.0	Pass
#2	35.19	0.19	0.24	1.0	Pass
#3	35.18	0.18	0.23	1.0	Pass
#4	35.21	0.21	0.23	1.0	Pass
#5	34.80	-0.20	0.23	1.0	Pass
#6	35.08	0.08	0.32	1.0	Pass
#7	35.40	0.40	0.25	1.0	Pass
#8	34.88	-0.12	0.24	1.0	Pass
#9	35.16	0.16	0.23	1.0	Pass

Correction of UUC.\* = Measured Temperature - Desired Temperature

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

### The End of Statements of Conformity

# Preventive Maintenance Scrubber

Service No. PM23-S08-040

## 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  คุณฉัตรณารัตน์ Tel: Fax:	K-415	1000122494	03 Mar 2023 PM 1/2



## 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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## 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  $\text{Na}_2\text{CO}_3$  in 3 L distilled warm water, or
  - dissolve 1.7 kg  $\text{Na}_2\text{CO}_3$  in 10 H<sub>2</sub>O in 3 L distilled warm water

Washing solution

☒ OK

☐ NOT OK



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## Preventive Maintenance Scrubber

### 3. Summary

All specifications OK	Specification not OK
PASS	

#### Comments

PM1-2

- เครื่องใช้งานได้ปกติ



Signature BUCHI

- Service by

Date 03 Mar 2023

- Approve by

Date 17 Apr 2023



Buchi (Thailand) Limited

# Preventive Maintenance Kjeldahl

Service No. PM23-S08-040

## 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  คุณธัญญารัตน์ Tel: Fax:	K-350	1000117313	03 Mar 2023 PM 1/2

## 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	/		



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## 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 <sub>2</sub> O	-		
- Adding NaOH	/		
- Adding H <sub>3</sub> BO <sub>3</sub>	-		
- Aspiration	-		



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## 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 <sub>2</sub> O	-		
- Diaphragm pump for NaOH	/		
- Diaphragm pump for H <sub>3</sub> BO <sub>3</sub>	-		

### 2.8 Program test

	OK	NOT OK	Remark
- Distillation	/		
- Aspiration	-		
- Preheating	/		
- Cleaning	/		



## Preventive Maintenance Kjeldahl

### 3. Function Test

Addition H <sub>2</sub> O	0 ml	Reaction time	0 min
Addition NaOH	0 ml	Distillation time	5 min
Addition H <sub>3</sub> BO <sub>3</sub>	0 ml	Steam capacity	100%
		Aspiration	SAM

Result: Water in receiving vessel now approximately 165 ml, 168 ml

### 4. Summary



All specifications OK	Specification not OK
Pass	

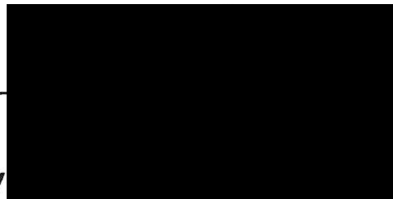
#### Comments

PM1-2

- เครื่องใช้งานได้ปกติ

#### Signature BUCHI

- Service by



Date 03 Mar 2023

- Approve by

Date 17 Apr 2023



Buchi (Thailand) Limited

## Preventive Maintenance IR Digestion

Service No. PM23-S08-040

### 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  คุณธัญญารัตน์ Tel: Fax:	K-436	1000122502	03 Mar 2023 PM 1/2

### 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	/		



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## 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

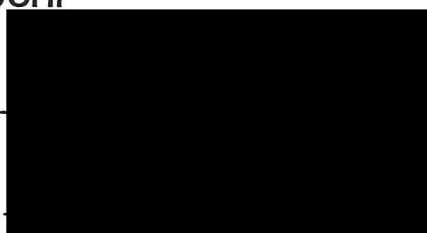
PM1-2

- เครื่องใช้งานได้ปกติ



#### Signature BUCHI

- Service by



Date 03 Mar 2023

- Approve by

Date 17 Apr 2023

