




ภาคผนวก 11



เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์


	Hanna Instruments (Thailand) Ltd. 410/67-68 Soi Ratchadapisek 24, Ratchadapisek Rd., Samsen-nok, Huaykwang, Bangkok 10310 Tel: 0-2541-4199 Fax: 0-2541-4198		
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Certificate No. : HIT-2522-0864
Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment :	Advanced pH/ORP/Temperature Benchtop Meter		
Meter Model :	HI6221-02	Serial No. :	102180040111
Probe Model :	HI1053B	Serial No. :	1140205N
Resolution (pH) :	0.01	Resolution (mV) :	0.1
Manufacturer :	Hanna Instruments	Made in :	Romania
Condition As-Received :	New Product	Reference :	RE250928
Ambient Temperature :	(25 ± 2) °C	Relative Humidity :	(50 ± 15) % RH
Customer name :	SPECIAL LAB ENVI AND CONSULTANT CO., LTD. 47/91-93 Moo.3 , T. Tha-it, A. Pakkret, Nonthaburi 11120		
Received date :	21 May 2025		
Calibrate date :	26 May 2025		
Issue date :	26 May 2025		
Calibrated Location :	Hanna Instruments (Thailand) Ltd.		
Calibration Procedure :	This calibrator was conducted by using in-house: calibration procedure CP-01, CP-02 by using certified reference material (CRM).		

Calibrated by :  Mr. Pichit Petthong	Approved by :  Mr. Anan Suwanchaisakul Authorized Signatory
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This certificate was certified only for the instrument we calibrated.
This result of calibration was found accurate on date and place of calibration only.

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approval of the head of Hanna Instrument (Thailand)



Certificate No. : HIT-2522-0864

Page : 2 of 2

Condition of this calibration result

1. Reference Standard Instruments : This certification is traceable to the international unit of unit maintained through:

Instruments	Model	Serial No.	Certificate No.	Traceable
Documenting Process Calibrator	Fluke 753	43160061	25E299	Technology Promotion Association (Thailand-Japan)
Thermometer with sensor	HI98509	36943D	24T1281	
Digital Thermo-Hygrometer	HT-771SD	AL07155	25H171	

2. Reference Standard Materials : pH calibration standard traceable thru CPA chem Ltd.

Buffer Solution	Manufacture	Certified Value	Lot Number	Exp. date
pH 4.0	CPA chem	$4.007 \pm 0.006 @ 25^{\circ}\text{C}$	1086537	26 April 2026
pH 7.0	CPA chem	$6.965 \pm 0.007 @ 25^{\circ}\text{C}$	1074440	8 February 2026
pH 10.0	CPA chem	$10.011 \pm 0.008 @ 25^{\circ}\text{C}$	1086538	26 April 2026

Calibration Result :

1. Performing standard curve by Simulator at: -177.5, 0.0, 177.5 mV

(Measurement Electrical Potential) After Adjust Result.

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)
	pH	mV	pH	mV	
pH Meter S/N 102180040111	4.01	177.5	4.01	177.5	0.097
	7.01	0.0	7.01	0.0	0.058
	10.01	-177.5	10.01	-177.5	0.097

2. Performing three buffer standard curve by using buffer nominal : pH 4,7,10 After Adjustment.

Unit Under Calibration	Standard pH Buffer Solution	Actual Reading (pH)	Actual Reading (mV)	Uncertainty of Measurement (\pm pH)
pH Electrode S/N 1140205N	4.007	4.01	181.4	0.011
	6.965	6.97	7.7	0.012
	10.011	10.01	-170.5	0.014

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

** End of certificate **



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL.0-2717-3000-29 FAX.0-2719-9484



Certificate of Calibration

Cert.No.: 25CH644

Page.: 1 of 3

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUAact-PH130
Serial No. : D08C0004
ID No. : -
Condition As-Received: Used Item
Received Date : 02 June 2025
Calibration Date : 05 June 2025
Reference : 2506-0035WN-1
Submitted by : Special Lab Envi And Consultant Co.,Ltd
47/91-93 Moo 3 Thambon Tha-it, Pakkret
Nonthaburi 11120

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage
standard and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Khit Ruttanapapachai

Approved by : _____
Approved Signatory

() Chakrit Waewwanjua
() Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 6 June 2025

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No.: 25CH644

Page.: 2 of 3

Condition of this calibration result**1. Reference Standard Instrument**

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	43160066	130RC092	25E1217	17 Apr 2026
2) Ref. Standard Thermometer	2188080	130RC044	24I1022	16 Sep 2025

- This measurement result is traceable to SI through Technology Promotion Association (Thailand - Japan)

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.007	CPA chem	1066665	18 Jan 2027
pH 6.865	CPA chem	940103	02 Nov 2025
pH 9.180	CPA chem	1066668	18 Jan 2026

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

Calibration Results

Function : mV Measurement

Performing standard curve by Document Process Calibrator at pH (4,7,9)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: D08C0004	4.00	177.48	177	4.00	0.58	2.00
	6.86	8.28	8	6.86	0.58	2.00
	9.18	-128.97	-129	9.18	0.58	2.00



Cert.No.: 25CH644

Page.: 3 of 3

Calibration Results**Function : pH Measurement**

Performing three buffers standard curve by using buffer nominal pH (4,7,9)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (\pm)	Coverage factor k
pH Electrode S/N.: 988E0098	4.007	4.02	146	0.0086	2.05
	6.865	6.87	-16	0.043	2.65
	9.180	9.20	-135	0.045	2.65

Function : Temperature Measurement**(*) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : 9651

- Serial No. : 988E0098

Dimension of probe

- Length : 100 mm.

- Diameter : 16 mm.



- Immersion Depth : 90 mm.

Calibration Point ($^{\circ}\text{C}$)	Standard Temperature ($^{\circ}\text{C}$)	UUC* Reading ($^{\circ}\text{C}$)	Error ($^{\circ}\text{C}$)	Uncertainty of measurement (\pm $^{\circ}\text{C}$)	Coverage factor k
25.0	25.005	25.0	-0.005	0.13	2.00
30.0	30.004	30.0	-0.004	0.13	2.00
40.0	40.004	40.0	-0.004	0.13	2.00

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

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CAL
Calibratech Co.,Ltd.
7/106-7 Moo 2, Sukhprachasan 3 Rd., Banggood, Pakkred, Nonthaburi 11120
Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com


NSC-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 68-300307-6 **Page : 1 of 2**

Submitted by : Special Lab Envi and Consultant Co., Ltd.
47/91-93 Moo 3, Tambol Tha-It, Pakkret, Nonthaburi 11120

Equipment : Burette
Manufacturer : Witeg Class : A
Capacity : 25 ml Graduation : 0.05 ml
ID No. : LB-Gw-001

Environment : Ambient Temperature : (20 ± 3) °C
Relative Humidity : (50 ± 10) %
Air Pressure : 1009.5 mbar.


Date of Received : 19 April 2025
Date of Calibration : 25 April 2025
Date of Issue : 25 April 2025
Calibrated by : Areerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-22


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

Electronic Balance

ID.No.	Cert.No.	Due Date	Traceability
241005	67-200410-4	02 Jun 2025	National Institute of Metrology (Thailand) (NIMT)

Approved by : 
(Wipa Tovadee)
Supervisor

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CAL-F0031-03

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Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com

Certificate of Calibration

Certificate No. : 68-300307-6

Page : 2 of 2

Result of Calibration : This result of true Volume is referred to standard temperature at 20 °C

UUC Condition As-Received : Good

Delivery Time : 40.04 sec.


Nominal Volume (ml)	Measuring Volume (ml)
10	10.0003
20	20.0098
25	25.0101


Uncertainty of measurement with in \pm 0.0066 ml

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


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

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CAL-F0031-03



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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 68-400236-1

Page : 1 of 2

Submitted by : Special Lab Envi and Consultant Co., Ltd.
47/91-93 Moo 3,Tambol Tha-It, Pakkret, Nonthaburi 11120

Equipment : Digital Thermometer with Thermocouple probe Type K
Temperature Indicator
 Manufacturer : Thermo Scientific Model : TEMP 10K
 Range : -250 °C to 1372 °C Resolution : 0.1 °C
 Serial No. : 4008958 ID No. : LB-Eq-013

Environment : Ambient Temperature : (23 ± 2) °C
 Relative Humidity : (50 ± 15) %
 Line Voltage : (220 ± 22) VAC

Date of Received : 19 April 2025
Date of Calibration : 22 April to 24 April 2025
Date of Issue : 24 April 2025
Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003 by compared with PRT in the liquid bath at the constant controlled temperature.
 The temperature scale used was based on ITS-90


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

1. Platinum Resistance Thermometer (PRT)

ID.No.	Cert. No.	Due Date	Traceability
400001	TT-0023-24	16 Feb 2026	National Institute of Metrology Thailand (NIMT)
400016	TT-0053-23	15 May 2025	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer


ID.No.	Cert. No.	Due Date	Traceability
400003	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)
400004	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)

Approved by : 

(Permon Chanpu)
Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 68-400236-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement with Thermocouple probe Type K

Model : Type K Sheath Material : Teflon
 Diameter : 2 mm. Length : 1500 mm.
 Serial No. : N/A ID No. : SL-39

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
130	3.0028	3.5	-0.5	0.18
130	20.0022	20.5	-0.5	0.18
130	104.0020	104.2	-0.2	0.45
130	150.0022	150.3	-0.3	0.58
130	180.0023	178.8	1.2	0.65

Model : AD-1218-230 Sheath Material : Stainless
 Diameter : 3.5 mm. Length : 230 mm.
 Serial No. : N/A ID No. : SL-40

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
124	380.0057	379.5	0.5	1.5
124	399.9903	399.3	0.7	1.6

Remark

UUC : Unit Under Calibration

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

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

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

Certificate of Testing

Cert.No.: 25TW23

Page.: 1 of 2

Equipment : DO Meter
Manufacturer : Hanna
Model : HI98193
Serial No. : 09120032101
ID No. : LB-Eq-014
Received Date : 04 February 2025
Test Date : 05 February 2025
Reference : 2502-0115WN-1
Submitted by : Special Lab Envi And Consultant Co.,Ltd
47/91-93 Moo 3 Thambon Tha-it,
Pakkret, Nonthaburi 11120
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean
Approved by : 
Approved Signatory
() Chakrit Waewwanjua
() Ponpan Paipim
(✓) Saitip Meangmai
Issue Date : 5 February 2025



Cert.No.: 25TW23

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1. Burette	-	130BU10	23CG1172	22 Mar 2025
2. Balance	14233821	110RC001	24MM131	04 July 2025

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate 5-Hydrate AR	KEMAUS	2203162447	99.6%





Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: KC1N8943T

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.20	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced
other in full, without written approval of the laboratory

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Certificate of Calibration			
Certificate No. :	68-200127-1	Page : 1 of 2	
Submitted by :	Special Lab Envi and Consultant Co., Ltd. 47/91-93 Moo 3, Tambol Tha-It, Pakkret, Nonthaburi 11120		
Equipment :	Electronic Balance Manufacturer : AND Model : GR-200 Serial No. : 14245322 ID No. : LB-Eq-016 Capacity : 210 g Resolution : 0.0001 g		
Environment :	On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd. Ambient Temperature : (25.5 to 26.1) °C Relative Humidity : (56.6 to 57.0) % Air Pressure : 1008.0 mbar		
Date of Received :	19 April 2025		
Date of Calibration :	19 April 2025		
Date of Issue :	22 April 2025		
Calibrated by :	Satja Sangkhum		
Calibration Method :	In-house method CAL-M2001 based on UKAS Publication ref : LAB 14 Edition 7 - November 2022		
Reference Standard Instruments : This certification is traceable to the International System of Units Standard Weights			
<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
E261-E2624	C02242009	07 Nov 2025	National Institute of Metrology (Thailand), (NIMT)
		Approved by : 	
		(Surachai Promthong)	
		Laboratory Manager	
The Uncertainties are for a confidence probability of approximately 95%			
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CAL-F0031-03			

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Certificate of Calibration

Certificate No. : 68-200127-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.001	0.0000	0.00011
0.01	0.0000	0.00011
0.1	0.0000	0.00011
0.5	0.0000	0.00011
2	0.0000	0.00011
5	0.0000	0.00011
10	0.0000	0.00011
50	0.0001	0.00014
100	0.0001	0.00020
200	0.0000	0.00038

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

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

Eccentric error

Load test : 50 g

A	B	C	D	E
-0.0005	0.0002	0.0004	0.0002	0.0000

g



Repeatability

Load test : 200 g

Stdev. : 0.00005 g

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	บริษัท สเปซเซด เฮ็น เอนไว แอคส์ คอนสตรัคชั่น จำกัด	หน้าที่: 1 / 1
	แบบบันทึกการทวนสอบอุณหภูมิของ Heating block (COD)	วันที่บังคับใช้: 01 / 04 / 2563

1. Heating block (COD)

ผู้ผลิต: M.LAB รุ่น: DB 1602 Serial No.: 0141 วันที่ตรวจ: LB-Eg-012
 วันที่ทวนสอบ: 1 มีนาคม 2563 ทวนสอบครั้งที่ต่อไป: 1 กันยายน 2563

2. Digital Thermometer with TC Probe

ผู้ผลิต: Votronic Scientific รุ่น: Temp 10k Serial No.: 4001956 วันที่ตรวจ: LB-Eg-013
 ความละเอียด: 0.1 (°C) วันที่ทวนสอบ: 21 April 2563 ทวนสอบครั้งที่ต่อไป: 21 April 2025

3. ผลการทวนสอบ (ช่วงเวลา 1.00 น. - 16.30 น.)

อุณหภูมิห้อง: 16.4 (°C) ความชื้นสัมพัทธ์: 54.5 %

วัน/เดือน/ปี	Position No.	Set point (°C)	อุณหภูมิที่อ่านได้จากมาตรวัด (°C)	อุณหภูมิที่อ่านได้เทอร์โมมิเตอร์ (°C)			เกณฑ์การยอมรับ	สรุปผลการทวนสอบ		ผู้ทวนสอบ
				ครั้งที่ 1 (A)	ครั้งที่ 2 (B)	ค่าเฉลี่ยของอุณหภูมิ		ผ่าน	ไม่ผ่าน	
1/3/68	1	150.0	150.0	150.5	150.4	150.5	+2	✓		บุศกร
	2			150.4	150.3	150.4	+2	✓		
	3			150.0	151.0	151.0	+2	✓		
	4			150.1	150.2	150.1	+2	✓		
	5			150.4	150.3	150.4	+2	✓		
	6			150.2	150.3	150.3	+2	✓		
	7			149.9	149.8	149.8	+2	✓		
	8			150.1	150.1	150.1	+2	✓		
	9			150.4	150.5	150.5	+2	✓		
	10			150.2	150.3	150.3	+2	✓		
	11			149.9	149.9	149.8	+2	✓		
	12			151.0	151.1	151.1	+2	✓		
	13			149.9	149.9	149.9	+2	✓		
	14			150.8	150.9	150.9	+2	✓		
	15			150.5	150.2	150.4	+2	✓		
	16			151.0	151.0	151.0	+2	✓		
	17			149.9	149.8	149.9	+2	✓		
	18			150.3	150.3	150.3	+2	✓		
	19			149.9	150.0	150.0	+2	✓		
	20			151.2	151.2	151.2	+2	✓		
	21			150.2	150.3	150.3	+2	✓		
	22			150.0	150.0	150.0	+2	✓		
	23			150.5	150.6	150.6	+2	✓		
	24			150.8	150.6	150.7	+2	✓		
	25			151.2	151.3	151.3	+2	✓		

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Certificate of Calibration

Certificate No. : 68-400223-2

Page : 1 of 2

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

Equipment : Temperature controlled enclosure(Incubator)
Manufacturer : Lovibond Model : FKU 1800
Range : N/A °C Resolution : 0.1 °C
Serial No. : 0914643-01 ID No. : LB-Eq-004

Environment : On site calibration was carried out at the Laboratory, Special Lab Envi and Consultant Co., Ltd.
Ambient Temperature : (26.0 to 26.5) °C
Relative Humidity : (45 to 50) %
Line Voltage : (226.0 to 226.5) V

Date of Received : 19 April 2025

Date of Calibration : 19 April 2025

Date of Issue : 25 April 2025

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20
The temperature scale used was based on ITS-90

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

ID No.	Cert. No.	Due Date	Traceability
400046 & 400042	68-400007-1	28 Jul 2025	National Institute of Metrology Thailand (NIMT)

Approved by :

(Permpon Chanpu)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com

Certificate of Calibration

Certificate No. : 68-400223-2

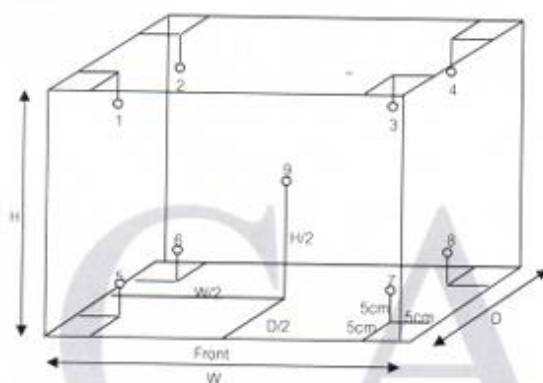
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Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.55 m

D = 0.73 m

H = 0.50 m

Capacity = 0.20 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.										Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	10	
20.0	20.0	20.0	20.35	20.26	20.28	20.31	20.21	20.09	20.29	20.17	20.22	20.22	0.63

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	20.0	0.22	0.34	0.85

Remark The uncertainty is not combine uniformity of the air chamber

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

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

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