

ภาคผนวกที่ 4

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สรุปเอกสารสอบเทียบอุปกรณ์เครื่องมือ

เอกสารการสอบเทียบเครื่องมือตรวจวัดคุณภาพน้ำ

		<b>CERTIFICATE OF CONFORMITY</b>	
<b>Aquion System</b>			
This certificate is to verify that the instrument referenced below by serial number meets or exceeds all Thermo Scientific functional specification and release requirements.			
Instrument Serial Number:	221280114	Firmware Version:	3.1.0
Instrument Module Type:	22175-60018	<b>Aquion Final Test</b>	
<input checked="" type="checkbox"/> Pump Calibration, Ripple and Accuracy		<input checked="" type="checkbox"/> Injection Valve Precision	
<input checked="" type="checkbox"/> Suppressor Current, Cal and Accuracy		<input checked="" type="checkbox"/> Relay and TTL I/O Test	
<input checked="" type="checkbox"/> Column Heater, Cal and Check		<input checked="" type="checkbox"/> Injection Valve Functionality	
<input checked="" type="checkbox"/> Detector Heater, Cal and Accuracy		<input checked="" type="checkbox"/> Leak Sensors	
<input checked="" type="checkbox"/> Conductivity Detector Cal, Noise and Linearity		<input checked="" type="checkbox"/> Leak Sensor Accuracy	
<input checked="" type="checkbox"/> Degass Calibration		<input checked="" type="checkbox"/> Eluent Generator Calibration	
Tester's Signature:	Angel Ruiz	Date:	22 Dec 2022
		60-095656 Rev B	

# Aqion Pump Summary Test Report

Instrument Name	Model	Serial Number	Moduleware
Pump	Aqion	221280114	3.1.0
Detector		221260053	

Sequence Name: 1\_Aqion\_Pump\_FQO  
Sequence Run Date: 22 Dec 2022  
Sequence Comment: Aqion Pump Test Final

Flow Accuracy Test				
Test Run	Pressure	Measured	Flow Rate	Accuracy
Flow Accuracy: 1mL/min	2132	0.9988	0.115%	Pass
Flow Accuracy: 2mL/min	2467	1.9980	0.099%	Pass

Pressure Ripple Test				
Test Run	Pressure	Measured	Pressure Ripple	
Flow Accuracy: 1mL/min	2132	0.080%	≤ 0.30%	Pass
Flow Accuracy: 2mL/min	2467	0.121%	Pass	Pass

Angel Ruiz  
Test Technician

22 Dec 2022

Date

# Aqion Detector Summary Test Report

Instrument Name	Model	Serial Number	Moduleware
Pump	Aqion	221280114	3.1.0
Detector		221260053	

Sequence Name: 2\_Aqion\_Detector\_FQO  
Sequence Run Date: 22 Dec 2022  
Sequence Comment: Aqion Final Test Detector

Dummy Load				
Test Run	Cell Heater	Measured	Background Signal	
Cell Dummy Load and Warm up	34.9 - 35.2	Pass	18.9 - 23.1	Pass
	35.016	Pass	20.211	Pass

Detector Noise & Drift Test				
Test Run	Background Signal	Measured	Drift	Noise
Cell DI Water Noise and Drift	0.05 - 0.60 µS	Pass	≤ 10.0 nS/hour	≤ 0.2 nS
	0.090 µS	Pass	4.715 nS/hour	0.139 nS
			Pass	Pass

Detector Linearity Test				
Test Run	Correlation Coefficient	Measured	%RSD	Calibration Curve
Cell Linearity Test 5 ppm	≥ 0.999	Pass	≤ 5.0 %	Slope
	0.99998	Pass	4.30	Offset
			Pass	0.000
				0.553

Injector Precision Test				
Test Run	Average	%RSD	Retention Time	
Injector Precision: 50 ppm	2.576 µS*min	0.106%	Average	Max-Min
			0.373 min	0.0100 min
			Pass	0.0100 min
				0.0100 min

Angel Ruiz  
Test Technician

22 Dec 2022

Date



# Thermo Aquion System Calibration Summary

Instrument Name	Model	Serial Number	Moduleware	Calibration	Value
Module	Aquion	221280114	3.1.0	Column Calibration	12/22/2022

Column Heater	Column Calibration	0.000
	Electrical Offset	1.96
	Heater Offset	1.02

Pump	Pressure Calibration	12/22/2022
	Pressure Transducer Offset	1576.00
	Pressure Transducer Slope	0.363
	Flow Rate Calibration	12/22/2022
	Flow Rate Parameter	5.4
	Flow Rate Nominal Speed	3845
	Flow Rate Slope	0.93

Detector	Detector Calibration	12/22/2022
	Fine Offset	251260.77
	Fine Slope	0.000000025
	Mid-Range Offset	28004.72
	Mid-Range Slope	0.000000409
	Coarse Offset	17014.44
	Coarse Slope	0.000002016
	Cell Constant	153.13
	Cell Heater Calibration	12/22/2022
	Electrical Offset	0.000
	Calibration Temperature	35.00
	Cell Serial Number	221260053

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Electrical and Electronic Products Restriction of Hazardous Substances Management Measures  
For applicable products, the Hazardous Substance Information Table is located at:  
<http://www.thermofisher.com/us/en/home/technical-resources/rohs-certificates.html>



Harikul Science Co., Ltd.  
694 Soi Ratchadaviv 24, Pacharatbampien,  
Samsaenok, Huaihwang, Bangkok 10310  
Tel: 0-2274-2456 Fax: 0-2274-2443  
Email: info@harikul.com www.harikul.com

CERT No.: HS-T0591

Certificate of Calibration

Calibration Date: 1 Sep 22

Submitted by: C.E.M TECHNOLOGY (THAILAND) Co., LTD.

219/43 Moo 12, Petchkasem Road, Omnoi, Krathumban, Probe

Samutsakom 74130

Model : YSI 5000

S/N : 18L109487

S/N : YSI 5010

S/N : 22G100123

ID NO.

Air Temp ref : S/N: E00522

Barometric ref : S/N: E00522

Water Temp ref : S/N: 11431

Avg Room Temp : 20 °C

Avg Water Temp : 20 °C

Air Pressure : 760.00 mmHg

Salinity : 0 ppt

Technician : Kittipong M.

## Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.09	(PASS)	-
Measurement 2 (mg/l)	9.09	(PASS)	-
Measurement 3 (mg/l)	9.09	(PASS)	-
Measurement 4 (mg/l)	9.09	(PASS)	-
Measurement 5 (mg/l)	9.09	(PASS)	-
Measurement 6 (mg/l)	9.08	(PASS)	-
Measurement 7 (mg/l)	9.09	(PASS)	-
Measurement 8 (mg/l)	9.09	(PASS)	-
Measurement 9 (mg/l)	9.09	(PASS)	-
Measurement 10 (mg/l)	9.09	(PASS)	-

Mean Measurement	9.09	mg/l
Inaccuracy	0.00	mg/l

Overall Status (PASS)

## Manufacturer Specification

Accuracy = +/- 0.02 mg/l

- 1) This certificate is issued based on the result that are found as shown on date and place of test only.
- 2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
- 3) This result shall not be used for advertising purpose.

*[Signature]*

Technician Signature

*[Signature]*

Laboratory Manager



## Calibration Result

Instruments Information			
Calibration Package Number	TR2022001		
Instruments Type	Gas Chromatograph		
Serial Number	4B1774	Model	KONIK GC 4000B
Installation Date	End of Warranty		
S.O. Number	P.O. Number		
Firmware Version	DPFC Rom Ver.		
Left Injection	-	Right Injector	S/SL
Left DPFC	-	Right DPFC	-
Left Detector	-	Right Detector	FID
Left DGFC	-	Right DGFC	-
Auxiliary Detector	-	Valve/Valve Oven	-
Last Validation	December 21, 2022	Next Validation	December 21, 2023
Last Preventive Maintenance	December 21, 2022	Next Preventive Maintenance	December 21, 2023
Data System Type	N2000	Data System Version	3.1.1

Gases Information			
Injector		Detector	
Left Carrier	-	Right Carrier	Helium, 3.0mL/min
Left Detector	-	Right Detector	FID
Gas 1	-	Gas 1 (Hydrogen)	Hydrogen, 40mL/min
Gas 2	-	Gas 2 (Make-up)	Nitrogen, 30mL/min
Gas 3	-	Gas 3 (Air)	Air Zero, 350mL/min

Service Engineer Signature: \_\_\_\_\_

(Teerapon Tawonwong)

Date: \_\_\_\_\_

21.12.2022



# CERTIFICATE OF System Validation

*This certificate was provided by Amani Corporation limited. To certifies that the instruments referenced below have passed system Validation tests and complies with the requirements of the specified set of test*

Validation Package Number : TR2022001  
 Instruments : GC  
 Model : KONIK GC 4000B  
 Serial No : 4B1774  
 Location : C.E.M. Technology (Thailand) Co., Ltd.

  
 Amani Corporation Limited  
  
 December 21, 2022  
 Service Engineer : \_\_\_\_\_  
 (Teerapon Tawonwong)

## Gases Flow Rate Validation Result

Carrier Gases			
Set point (mL/min)	Measured (mL/min)	Criteria (mL/min)	Status
25	25.0	24.0-26.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail
Detector Gases			
Reference Gas			
Set point (mL/min)	Measured (mL/min)	Criteria (mL/min)	Status
Low	9.3	8.0-12.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail
High	46.7	45.0-55.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail
Make-up Gas			
Set point (mL/min)	Measured (mL/min)	Criteria (mL/min)	Status
Low	9.7	8.0-12.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail
High	31.3	28.0-32.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail

Service Engineer Signature:

(Teerapon Tawonwong)

Date:

21.12.2022

Calibration Result

Page 2 of 1

## Temperature Validation Result

Injector Temperature			
Set point (°C)	Measured (°C)	Status	Note
60 +/- 1.0	60.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail	
Detector Temperature			
Block Temp			
Set point (°C)	Measured (°C)	Status	Note
60 +/- 1.0	60.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail	
Transfer Temp			
Set point (°C)	Measured (°C)	Status	Note
60 +/- 1.0	60.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail	
Column Oven			
Set point (°C)	Measured (°C)	Status	Note
40 +/- 1	40.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail	RTD OFFSET = 6.2
120 +/- 1	120.0	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Fail	

Service Engineer Signature:

(Teerapon Tawonwong)

Date:

21.12.2022

Calibration Result

Page 3 of 1

## Parts Referenced

Part	Description	Note
Analytical Column	Capillary Column RTX-5 Film : 0.25 um Length : 7 Meter Diameter : 0.32 mmID	Reference With : Restek
Standard Sample	FID Performance Evaluation Sample Kit	Manufactured By Agilent Technologies. 5080-8842 Lot: 0006604151
Sample Injection	Syringe 10 ul	Manufactured By SGE



Service Engineer Signature:

*Sm.*  
(Teerapon Tawonwong)

Date:

*21.12.2022*

## Operating Condition

Parameter	Condition
<b>Environmental</b>	Temperature 25.0 °C Relative Humidity 45.7 °C  <b>Gases</b> - Carrier Gas : Helium = 1ml/min - Hydrogen = 35 ml/min - Air = 350 ml/min - Make-up Gas: Nitrogen = 30ml/min  <b>Oven</b> - Initial Temperature = 50°C - Initial Time = 1 minute - Ramp 1 = 20 °C/minute - Final Temperature = 200°C - Final Time = 1 minute
<b>Instrument Condition</b>	<b>Injector</b> - Operating Mode = Split - Temperature = 230 °C - Split Flow 40. ml/min - Purge Flow rate = 5 ml/min  <b>Detector</b> - Base Temperature = 250 °C - Detector Signal Range = 10°  <b>Injected Volume</b> - 1 µl + needle of Test Mixture

Service Engineer Signature:

*Sm.*  
(Teerapon Tawonwong)

Date:

*21.12.2022*





## Certificate of Calibration

**Equipment:** Cooled Incubator  
**Model:** KB 240  
**Serial No.(or ID):** 20180000012164 (WW-16-001)  
**Manufacturer:** Binder  
**Condition:** In Condition  
**Shelves(pc.):** 3

**Customer:** C.E.M Technology (Thailand) Co., Ltd.  
31/8 Moo 13, Tambon Raikhing,  
Amphur Sampran, Nakhonpathom 73210 Thailand.

**Environment Condition:** Temperature: 22 °C ± 1.9 °C  
Humidity: 72 %RH ± 6.2 %RH  
Voltage: 229 VAC ± 3.1 VAC

**Calibration Place:** C.E.M Technology (Thailand) Co., Ltd. ( Laboratory Room )  
219/43 Moo 12 Petchkasem Road,  
Omnoi Krathum Baen, Samut Sakhon 74130 Thailand

**Calibration By:** Mr. Suphanimit Khamnonphoem  
**Calibration Date:** 15 February 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 SPC RT Co., Ltd. Certificate No. C10220016

(Mr. Suphanimit Khamnonphoem)

Person in charge

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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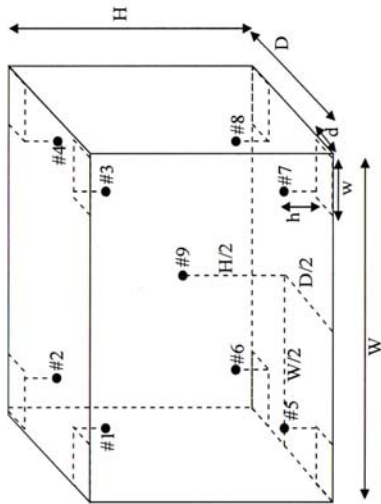
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CAL-FM-C31-10: 12 Sep 2022



Certificate No.: C31230380

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### Standard Installation Locations

Volume (Calibration Zone)= 125 (Liters)

Inside chamber: W = 65 (cm) D = 49 (cm) H = 79 (cm)

Standard Locations (#1, #2, #3, #4): w = 7 (cm) d = 5 (cm) h = 8 (cm)

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

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CAL-FM-C31-10: 12 Sep 2022



### Calibration Results: Without 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	20.20	0.20	0.34
#2	20.07	0.07	0.37
#3	20.02	0.02	0.36
#4	19.96	-0.04	0.41
#5	20.07	0.07	0.35
#6	20.10	0.10	0.33
#7	19.84	-0.16	0.37
#8	20.08	0.08	0.36
#9	20.09	0.09	0.34

### 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	
20.0	20.0	20.0	20.20	20.07	20.02	19.96	20.07	20.10	19.84	20.08	20.09	0.41

### Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
20.0	0.30	0.27	0.80

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

  
(Mr. Udon Sirichana)  
Authorized signatory

### Without adjustment

Desired Temperature : 20.0 °C Tolerances : 1.0 °C

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

Locations	Measured (°C)	Correction of UUC, (°C)	Guard band (W) (± °C)	Tolerance (± °C)	Conformity
#1	20.20	0.20	0.34	1.0	Pass
#2	20.07	0.07	0.37	1.0	Pass
#3	20.02	0.02	0.36	1.0	Pass
#4	19.96	-0.04	0.41	1.0	Pass
#5	20.07	0.07	0.35	1.0	Pass
#6	20.10	0.10	0.33	1.0	Pass
#7	19.84	-0.16	0.37	1.0	Pass
#8	20.08	0.08	0.36	1.0	Pass
#9	20.09	0.09	0.34	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.

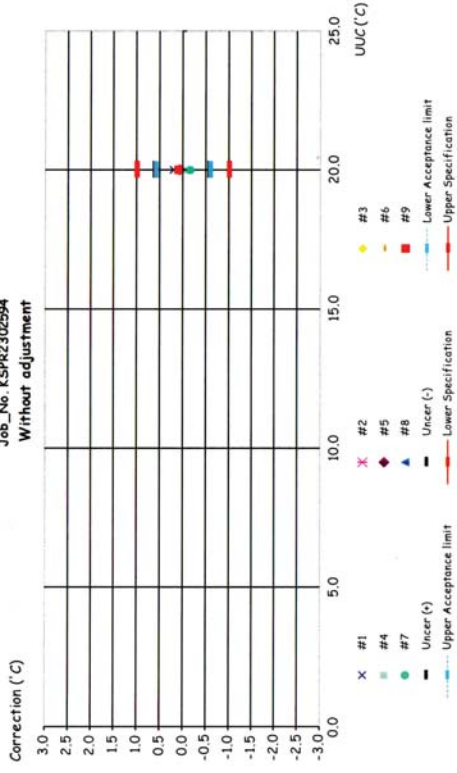
### The End of Statements of Conformity



Corr\_Distribution & Max\_Measurement Uncertainty

Job\_No. KSPR2302594

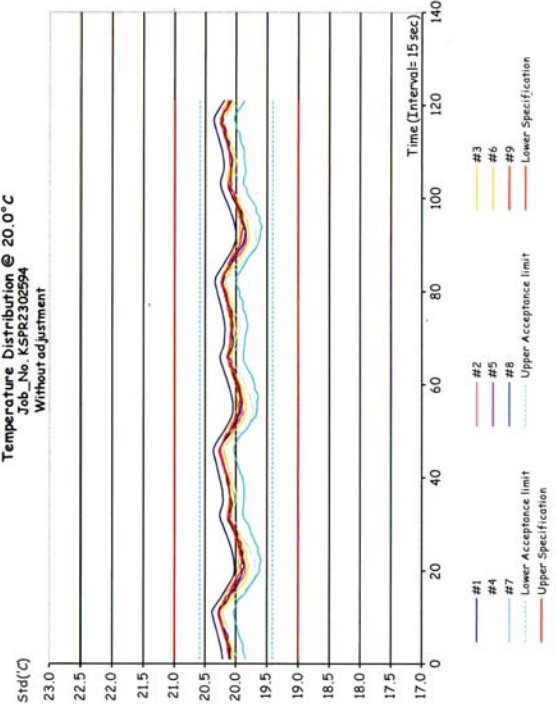
Without adjustment



Temperature Distribution @ 20.0°C

Job\_No. KSPR2302594

Without adjustment



ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2302594

ชนิดเครื่องมือ: Cooled Incubator

รุ่น: KB 240

หมายเลขเครื่อง: 20180000012164 ( WW-16-001 )

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
15 Feb 2023		15 Feb 2023		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
		General		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. การทำงาน ฟัดลม	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	6. สวิท Lever of Ventilation valve	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สวิท Lever door open / close	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สวิท Door seal	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. การทำงานของระบบ Safety	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. การทำงานของระบบทำความเย็น	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	11. การทำงานของระบบทำความร้อน	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. สวิทตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	13. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
				ไม่มี

ข้อแนะนำ :

Mr. Suphanimit Khamnonphoom  
Service Engineer





## Certificate of Calibration

**Equipment:** Hot Air Oven  
**Model:** UF 55  
**Serial No.(or ID):** B219.0142 ( WW-05-002 )  
**Manufacturer:** Memmert  
**Condition:** In Condition  
**Shelves(pc.):** 2

**Customer:** C.E.M Technology (Thailand) Co., Ltd.  
31/8 Moo 13, Tambon Raikhing,  
Amphur Sampran, Nakhonpathom 73210 Thailand.

**Environment Condition:** Temperature: 26 °C ± 1.2 °C  
Humidity: 55 %RH ± 5.4 %RH  
Voltage: 226 VAC ± 2.6 VAC

**Calibration Place:** C.E.M Technology (Thailand) Co., Ltd. ( Laboratory Room )  
219/43 Moo 12 Petchkasam Road,  
Omnoi Krathum Baen, Samut Sakhon 74130 Thailand

**Calibration By:** Mr. Apiwit Chaosap  
**Calibration Date:** 15 February 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 SPC RT Co., Ltd. Certificate No. C10220016

  
(Mr. Apiwit Chaosap)  
**Person in charge**

  
(Mr. Udon Srichana)  
**Authorized signatory**

This certificate is issued in 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 in 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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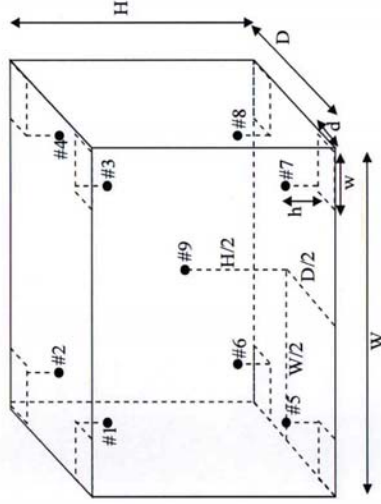
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CAL-FM-C31-10: 12 Sep 2022



Certificate No.: C31230315

Page: 2 of 4



### 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.

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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.

**DKSH Technology Limited**  
2533 Sukhumvit Road, 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:

#### 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	104.08	0.08	0.39
#2	103.99	-0.01	0.39
#3	104.30	0.30	0.39
#4	104.24	0.24	0.39
#5	104.33	0.33	0.39
#6	104.22	0.22	0.39
#7	103.71	-0.29	0.39
#8	104.24	0.24	0.39
#9	104.36	0.36	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	104.08	103.99	104.30	104.24	104.33	104.22	103.71	104.24	104.36	0.39

#### Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104.0	0.70	0.07	0.76

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	179.63	-0.37	0.46
#2	179.69	-0.31	0.45
#3	180.34	0.34	0.45
#4	180.23	0.23	0.45
#5	180.59	0.59	0.45
#6	180.23	0.23	0.45
#7	179.42	-0.58	0.48
#8	180.28	0.28	0.45
#9	180.67	0.67	0.46

#### 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	179.63	179.69	180.34	180.23	180.59	180.23	179.42	180.28	180.67	0.48

#### Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180.0	1.41	0.15	1.54

Note: \* Maximum uncertainty of the each position

### The End of Certificate





Refer to Certificate No.: C31230315 Page: 1 of 2

## 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



(Mr. Udon Srichana)  
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	104.08	0.08	0.39	1.0	Pass
#2	103.99	-0.01	0.39	1.0	Pass
#3	104.30	0.30	0.39	1.0	Pass
#4	104.24	0.24	0.39	1.0	Pass
#5	104.33	0.33	0.39	1.0	Pass
#6	104.22	0.22	0.39	1.0	Pass
#7	103.71	-0.29	0.39	1.0	Pass
#8	104.24	0.24	0.39	1.0	Pass
#9	104.36	0.36	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.

DKSH Measurement services Ltd. Co., Ltd.  
DKSH Temperature Calibration Services (Thailand) Co., Ltd.  
2533 Sukhumvit Road, Bangkok, Prachinburi, 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C31-10: 12 Sep 2022



Refer to Certificate No.: C31230315 Page: 2 of 2

## 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	179.63	-0.37	0.46	2.0	Pass
#2	179.69	-0.31	0.45	2.0	Pass
#3	180.34	0.34	0.45	2.0	Pass
#4	180.23	0.23	0.45	2.0	Pass
#5	180.59	0.59	0.45	2.0	Pass
#6	180.23	0.23	0.45	2.0	Pass
#7	179.42	-0.58	0.48	2.0	Pass
#8	180.28	0.28	0.45	2.0	Pass
#9	180.67	0.67	0.46	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

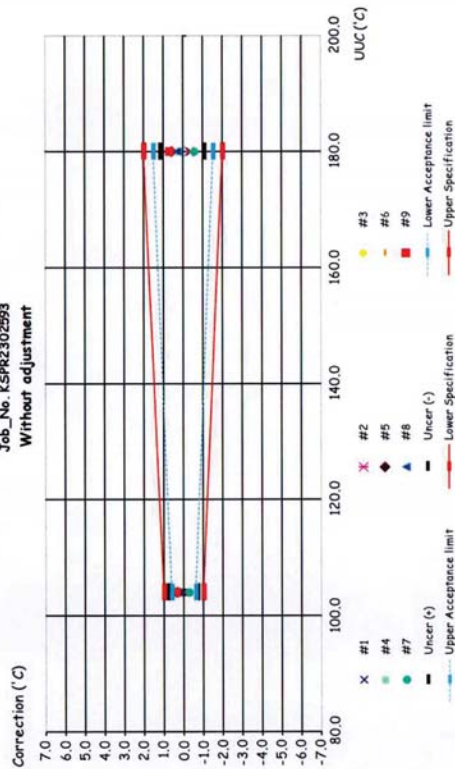
DKSH Measurement services Ltd. Co., Ltd.  
DKSH Temperature Calibration Services (Thailand) Co., Ltd.  
2533 Sukhumvit Road, Bangkok, Prachinburi, 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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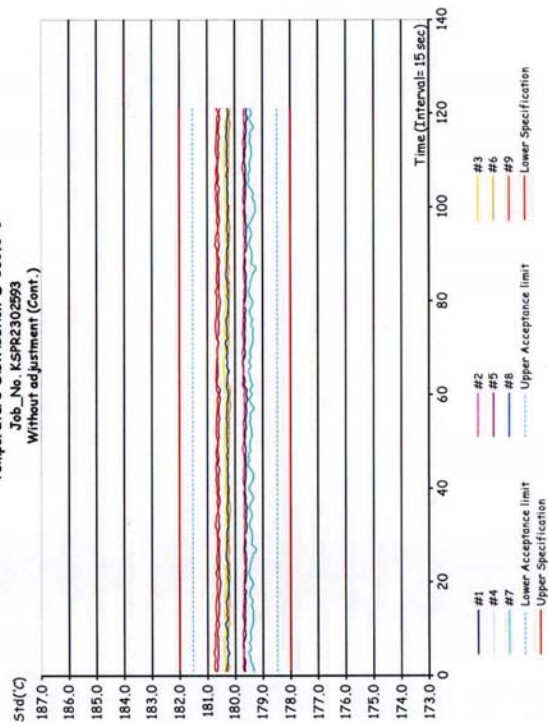
CAL-FM-C31-10: 12 Sep 2022



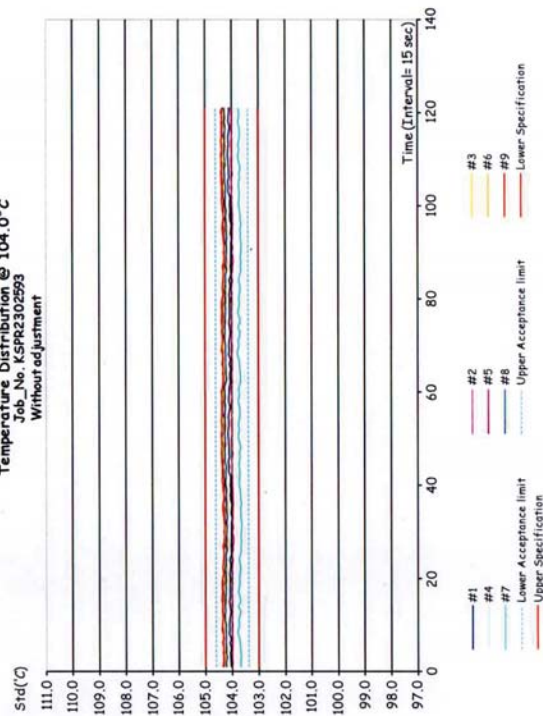
Corr\_Distribution & Max\_Measurement Uncertainty  
Job\_No. KSPR2302593  
Without adjustment



Temperature Distribution @ 180.0°C  
Job\_No. KSPR2302593  
Without adjustment (Cont.)



Temperature Distribution @ 104.0°C  
Job\_No. KSPR2302593  
Without adjustment





## ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2302593

ชนิดเครื่อง: Hot Air Oven

รุ่น: UF 55

หมายเลขเครื่อง: B219.0142 (WW-05-002)

ตรวจสอบ (รับ)	รายการตรวจสอบ	ตรวจสอบ (ส่ง)		หมายเหตุ
		15 Feb 2023	ผ่าน/ไม่ผ่าน	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
<b>General</b>				
<input checked="" type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	5. การทำงาน ฟัดลม	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	6. สวิท Lever of Ventilation valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	7. สวิท Lever door open / close	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	8. สวิท Door seal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	9. การทำงานของระบบ Safety	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	10. การทำงานของระบบทำความเย็น	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input type="checkbox"/>	11. การทำงานของระบบทำความร้อน	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	12. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	13. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ:

Mr. Apiwit Chaosap  
Service Engineer

DKSH Thailand Co., Ltd.  
2533 หมู่ 10 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/identify-thailand

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# CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasan 3 Rd., Banggood, Pakkred, Northaburi 11120  
Tel:(02) 964-0211 Fax:(02) 964-5155, e-mail: calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



NS-CAL-TIS 17025  
CALIBRATION 0036

## Certificate of Calibration

Page : 1 of 2

Certificate No. : 66-420017-1

Submitted by : C.E.M Technology (Thailand) Co.,Ltd.

219/43 Moo.12 Petchkasem Rd, Omnoi, Krathumban, Samutsakorn 74130 (Head Office)

Equipment : pH Meter with electrode

pH meter

Manufacturer : Thermo Scientific Model : VERSA STAR PRO

Range : N/A pH Resolution : 0.01 pH

Serial No. : 12260 ID No. : WW-03-001

Electrode

Model : 9156BNWP Serial No. : VV1-15843

Environment : On site calibration was carried out at the Laboratory C.E.M Technology (Thailand) Co.,Ltd.

Ambient Temperature : (22.0 to 22.6) °C

Relative Humidity : (55 to 58) %

Date of Received : 13 February 2023

Date of Calibration : 13 February 2023

Date of Issue : 18 February 2023

Calibrated by : Bunjerd Masri

Calibration Method : In-house method CAL-M4201 direct measurement by using standard voltage calibrator and using certified reference material (CRM)


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

1. Multiproduct Calibrator

ID No.	Cert. No.	Due Date	Traceability
400005	SG-E-00473/64	27 Aug 2023	National Institute of Metrology Thailand (NIMT)

2. Standard Buffer Solution

pH	Cert. No.	Lot No.	Exp. Date	Traceability
4.008	61235182	857394	11 Dec 2024	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
6.986	61267169	857395	11 Dec 2023	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
10.010	61260481	857396	11 Dec 2023	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025

Approved by :   
( Bunjerd Masri )  
Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03

Certificate of Calibration

Certificate of Calibration

Certificate No. : 66-420017-1 Page : 2 of 2

Certificate No. : 66-400084-1 Page : 1 of 2

Result of Calibration :

UUC Condition As-Received : Good

Function : Electrical measurement  
pH meter

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

Adjustment Curve at nominal pH	Applied Voltage ( mV )	Nominal Value ( pH )	UUC Reading		Correction ( mV )	Uncertainty ( ± mV )
			( pH )	( mV )		
4, 7, 10	177.4800	4	4.00	177.4	0.1	0.12
	0.0000	7	7.00	0.0	0.0	0.086
	-177.4800	10	10.00	-177.4	-0.1	0.12

Function : pH meter with electrode

Performing a three - buffer standard curve using buffer nominal pH (4,7,10)

Adjustment Curve at nominal pH	Standard Buffer ( pH )	UUC Reading ( pH )	Correction ( pH )	Uncertainty ( ± pH )
4, 7, 10	4.008	4.01	0.00	0.0097
	6.986	7.00	-0.01	0.011
	10.010	10.01	0.00	0.014

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%

- o10 -



Approved by :   
( Bunjerd Masri )  
Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

Certificate No. : 66-400084-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Immersion Depth ( mm. )	Standard Reading ( °C )	UUC Reading ( °C )	Correction ( °C )	Uncertainty ( ± °C )
120	25.004	25.0	0.0	0.19

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%

- 000 -

*(Signature)*



Bangkok High Lab Co.,Ltd.

4/176 Soi Ladplakao 66, Ladplakao Rd., Anusawari, Bangkok, Bangkok 10220

Tel: (662) 971-5800 Fax: (662) 971-5300

Website: www.bangkokhighlab.com E-mail: info@bangkokhighlab.com



NSC-TS-17025  
CALIBRATION 0366

## CERTIFICATE OF CALIBRATION

Certificate No : S2022/168

Page : 1/5

Order No : 316/2022

Customer : C.E.M Technology (Thailand) Co., Ltd

Address : 219/43 Moo 12 Phet Kasem Rd., Omnoi, Krathum Baen, Chachoengsao 24000

Instrument : UV/VIS spectrophotometer

Manufacture : MERCK

Model : Prove100

Serial Number : 1714112078

Environment : Temperature (26.6 - 26.4) °C

: Humidity (58 - 60) %RH

Received Date : September 29, 2022

Calibration Date : September 29, 2022

Issued Date : October 3, 2022

Calibrate Status : No Adjustment

Calibration Area : Customer area

Roomname : Laboratory Room of C.E.M Technology (Thailand) Co., Ltd

Calibrated By : JEERAPAT  
( Mr. Jeerapat Thaepphaisun )  
Calibration Engineer

Approved By : *(Signature)*  
( Mr. Wanchai Meesiri )  
Manager



Bangkok High Lab Co., Ltd.  
4/176 Soi Ladplakao 66, Ladplakao Rd., Anusawari, Bangkok, Bangkok 10220  
Tel: (662) 971-5800  
Website: www.bangkokhighlab.com E-mail: info@bangkokhighlab.com



NSC-TIS-TIS 17025  
CALIBRATION 0366

Certificate No : S2022/168  
Page : 2/5

## 1. Photometric Accuracy

CRMs: Neutral Density Glass Filters  
Traceability: Traceable to NIST, U.S.A. through Neutral density filters NIST SRM 930e & 1930, Double Aperture method through Sarna certificate report no. 108644

Spectral slit width : 4.00 nm

1.1 Reading scale at 420.0 nm

Filter STDs (Abs) Certificate	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
0.0000	0.000	0.0000	0.0028
0.4965	0.495	0.0015	0.0044
0.9630	0.960	0.0030	0.0038
2.0356	2.030	0.0056	0.0064

1.2 Reading scale at 440.0 nm

Filter STDs (Abs) Certificate	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
0.0000	0.000	0.0000	0.0028
0.4870	0.485	0.0020	0.0040
0.9433	0.942	0.0013	0.0040
1.9665	1.970	-0.0035	0.0064

1.3 Reading scale at 465.0 nm

Filter STDs (Abs) Certificate	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
0.0000	0.000	0.0000	0.0028
0.4535	0.454	-0.0005	0.0034
0.8780	0.879	-0.0010	0.0040
1.8424	1.840	0.0024	0.0060

1.4 Reading scale at 546.1 nm

Filter STDs (Abs) Certificate	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
0.0000	0.000	0.0000	0.0028
0.4706	0.469	0.0016	0.0028
0.9094	0.909	0.0004	0.0028
1.8755	1.875	0.0005	0.0064



Bangkok High Lab Co., Ltd.  
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Tel: (662) 971-5800  
Website: www.bangkokhighlab.com E-mail: info@bangkokhighlab.com



NSC-TIS-TIS 17025  
CALIBRATION 0366

Certificate No : S2022/168  
Page : 3/5

1.5 Reading scale at 590.0 nm

Filter STDs (Abs) Certificate	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
0.0000	0.000	0.0000	0.0028
0.4887	0.489	-0.0003	0.0029
0.9464	0.945	0.0014	0.0029
1.9021	1.899	0.0031	0.0061

1.6 Reading scale at 635.0 nm

Filter STDs (Abs) Certificate	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
0.0000	0.000	0.0000	0.0028
0.4634	0.463	0.0004	0.0030
0.8992	0.896	0.0032	0.0031
1.7824	1.776	0.0064	0.0062

## 2. Photometric Accuracy

CRMs: Potassium Dichromate in Perchloric acid

CRMs Serial Number: 15086

Traceability: Traceable to NIST, U.S.A. through crystalline potassium dichromate NIST SRM 935a through Sarna certificate report no. 88921

Blank Serial Number: 15178

Spectral slit width : 4.00 nm

Wavelength (nm)	Certificate (Abs)	Average Measured Value (A)	Correction (A)	Uncertainty $\pm$ (A)
235	0.0000	#N/A	#N/A	#N/A
	0.7340	#N/A	#N/A	#N/A
257	0.0000	#N/A	#N/A	#N/A
	0.8528	#N/A	#N/A	#N/A
313	0.0000	#N/A	#N/A	#N/A
	0.2873	#N/A	#N/A	#N/A
350	0.0000	#N/A	#N/A	#N/A
	0.6336	#N/A	#N/A	#N/A



Bangkok High Lab Co., Ltd.  
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Website: www.bangkokhighlab.com E-mail: info@bangkokhighlab.com



Certificate No : S2022/168  
Page : 4/5

### 3. Wavelength Accuracy

Spectral slit width : 4.00 nm

3.1 CRMs: Holmium Glass Filter  
CRMs Serial Number: W184/H  
Traceability: Traceable to NIST Holmium oxide filter NIST SRM 2034, through Starna certificate report no. 108651

Filter STDs (nm) Certificate	Average Measured Value (nm)	Correction (nm)	Uncertainty ± (nm)
241.74	#N/A	#N/A	#N/A
279.44	#N/A	#N/A	#N/A
287.98	#N/A	#N/A	#N/A
334.10	333.3	0.80	0.12
361.00	360.2	0.80	0.12
418.61	418.2	0.41	0.12
453.63	452.6	1.03	0.12
460.05	459.4	0.65	0.12
536.66	536.0	0.66	0.12
637.98	637.4	0.58	0.12

3.2 CRMs: Didymium Glass Filter  
CRMs Serial Number: W184/D  
Traceability: Traceable to NIST Holmium oxide filter NIST SRM 2034, through Starna certificate report no. 108652

Filter STDs (nm) Certificate	Average Measured Value (nm)	Correction (nm)	Uncertainty ± (nm)
585.29	584.8	0.49	0.12
684.49	683.6	0.89	0.12
740.18	739.2	0.98	0.12
748.48	747.4	1.08	0.12
807.03	806.1	0.93	0.12
879.27	878.5	0.77	0.12

Effective Date: 26/08/2022

F-SER-026 Rev 25



Bangkok High Lab Co., Ltd.  
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Tel: (662) 971-5800  
Website: www.bangkokhighlab.com E-mail: info@bangkokhighlab.com



Certificate No : S2022/168  
Page : 5/5

### 4. \*Stray Light

CRMs: Potassium Chloride aqueous solution  
CRMs Serial Number: 5469  
Traceability: Traceable to NIST, U.S.A. potassium chloride NIST SRM2032, through Starna certificate report no. 88922

Spectral slit width : 4.00 nm

Wavelength (nm)	Certificate	Average Measured
201.28	>2A	#N/A
201.28	<1%T	#N/A

### 5. \*Spectral Resolution

CRMs: Toluene in Hexane  
CRMs Serial Number: 8697  
Traceability: Traceable to toluene in hexane NIST SRM2034, through Starna certificate report no. 88923

Spectral slit width (nm)	Abs Ratio
0.5	#N/A
1.0	#N/A
1.5	#N/A
2.0	#N/A
3.0	#N/A

Note : \* "Not TISI Accredited" in this certificate have been included for completeness

### Remarks:

Calibrate Method

- 1.1 Photometric and Wavelength accuracy: In-house method W-SER-001 based on ASTM E925-02 and ASTM E275-01
- 1.2 Stray light: Measuring the CRMs in both absorbance and transmittance unit at wavelength 201.23 nm. Base on European Pharmacopoeia V.6.19.3.1984
- 1.3 Spectral resolution: Measuring the CRMs. The maximum absorbance values were read at closest to 268.7nm and the minimum absorbance values were read at closest 267.0 nm. Refer to European Pharmacopoeia V.6.19.3.1984
2. N/A = not available.
3. Uncertainty of Measurement: The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95%.
4. This result of calibration was found accurate as shown on date and place of calibration only.
5. This report will certify of calibrated equipment only.

- End of Report -

Effective Date: 26/08/2022

F-SER-026 Rev 25





## Certificate of Calibration

**Equipment:** Digital Thermometer with Sensor  
**Model:** TK 61  
**Serial No.:** 1P181269184  
**Manufacturer:** KIMO  
**Condition:** In Condition  
**Customer:** C.E.M Technology (Thailand) Co., Ltd.  
31/8 Moo 13, Tambon Raikhing,  
Amphur Sampran, Nakhonpathom 73210 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. Anat Karapitak  
**Calibration Date:** 16 February 2023  
**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  
National Institute of Metrology Thailand Certificate No. TT-0111-21

(Mr. Anat Karapitak)

Person in charge

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.  
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DKSH Technology (Thailand) Co., Ltd.  
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C15-14: 06 Dec 2022



Certificate No.: C15230305

Page: 2 of 2

### Calibration Results: Without Adjustment

Sensor Type: TC Type K

Diameter (mm) 2		Length (mm): -		Immersion (mm): 110		Channel: T1	
Calibrate Point (°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)	Correction of UUC (°C)	Uncertainty (± °C)		
20.0	20.0021	19.6	0.4021	0.4021	0.26		
104.0	104.0036	103.2	0.8036	0.8036	0.58		
150.0	150.0018	149.8	0.2018	0.2018	0.58		
180.0	180.0039	179.9	0.1039	0.1039	0.74		

The End of Certificate

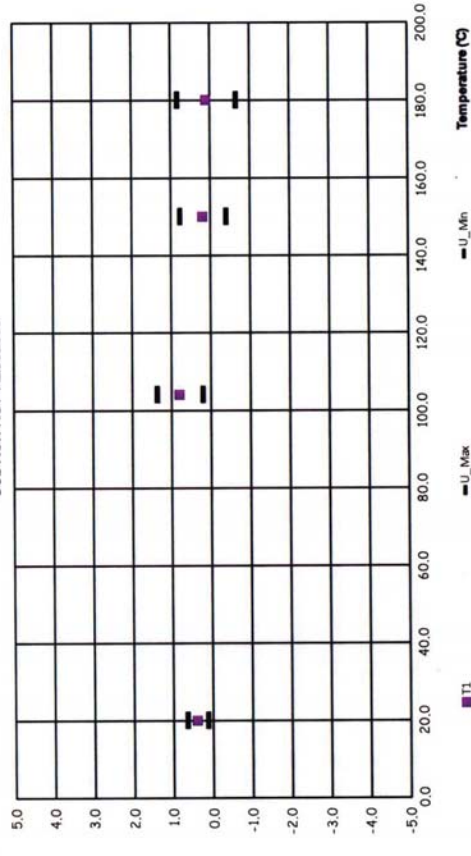
DKSH Technology (Thailand) Co., Ltd.  
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C15-14: 06 Dec 2022



Without Adjustment  
Job No.: KSPR2302595



## ใบตรวจสอบสภาพเครื่องมือวัดอุณหภูมิ

ชนิดเครื่องมือ: Digital Thermometer with Sensor  
หมายเลขเครื่อง: IP181269184  
เลขที่ใบงาน: KSPR2302595  
รุ่น: TK 61

ตรวจสอบ (รับ)		รายการตรวจสอบ		ตรวจสอบ (ส่ง)		หมายเหตุ
16-Feb-2023	ไม่ปกติ	รายการตรวจสอบ		16-Feb-2023	ไม่ปกติ	
ปกติ	ไม่ปกติ	General		ปกติ	ไม่ปกติ	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ		<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input type="checkbox"/>	<input type="checkbox"/>	2. Adapter / Power supply 220 / 110 VAC		<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Main Switch		<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การทำงาน Selector Key		<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. การแสดงผล Display		<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. Battery		<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง		<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาพ Sensor ( In / Ex )		<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ :

Mr. Anat Karapilak  
Service Engineer



THAI HEART CALIBRATION CO., LTD.

112/1 Moo 5, Phraek Sa, Muang, Samut Prakan 10280  
Tel: 0-2394-2162, 0-2757-8443; 0-2757-8496 Fax: 0-2757-8507



AC-2695

## CERTIFICATE OF CALIBRATION

Certificate No.: T1-2103001/23

Page 1 of total 4 pages

Customer: C.E.M TECHNOLOGY (THAILAND) CO., LTD.

219/43 Moo 12, Petchkasem Road, Omnoi,  
Krathumban, Samutsakorn 74130

Equipment	Thermo Reactor	Model	TR420
Manufacturer	Merck	ID No.	WW-07-002
Serial No.	19490640		
Description	Resolution of UUC : 1 °C		

Environmental Conditions  
Ambient Temperature: 24.5 °C  
Relative Humidity: 41 %  
Atmospheric Pressure: -

Calibration Location  
Received Date: 21 March 2023  
Calibration Date: 21 March 2023  
Date of Issue: 22 March 2023  
Condition of Artifacts: Used conditions but can be calibrated

Checked by 

Approved by 

Act as Technical Manager

Representative of Managing Director

( ) ( Krisyosl K. ) ( ) ( Sakda Y. )  
( ) ( Patiphan K. ) ( ) ( Onnapa P. )  
( ) ( Pongsak H. ) ( ) ( Nitiphong K. )  
( ) ( Kanung C. ) ( ) ( Nonthachai K. )  
( ) ( Pramong P. ) ( ) ( Noppol P. )

( Dr. Ekachai Purittitwong )

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FE-169

REV.02 02/24/21



THAI HEART CALIBRATION CO., LTD.

112/1 Moo 5, Phraek Sa, Muang, Samut Prakan 10280  
Tel: 0-2394-2162, 0-2757-8443; 0-2757-8496 Fax: 0-2757-8507



AC-2695

Certificate No.: T1-2103001/23

Page 2 of total 4 pages

Reference Method :

- The calibration method used was CP-142 based on an in-house method.
- The temperature scale used was an ITS-90.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

Reference Standard Instruments:

Type	Model	Serial No.	Cert. No.	Due Date	Traceability
Data Logger with Sensors	34972A/ 34901A	MY57010717/ MY59004982	10-1308001/22	Aug. 12, 2023	THC

Remark: This certificate is traceable to the International System of Unit (SI Unit) through:

- THC, Thai Heart Calibration Co., Ltd.

Calibrated by

Apisit

REV.02 02/24/21

FE-169



Certificate No.: TT-2103001/23

Page 3 of total 4 pages

Measurement Results:

(L)

Hole No.	UUC Setting (°C)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Stability of UUC (± °C)	Uncertainty (± °C)
# 1	150	148.1	150	-1.9	0.16	0.61
# 2	150	148.1	150	-1.9	0.15	
# 3	150	147.8	150	-2.2	0.11	
# 4	150	147.8	150	-2.2	0.18	
# 5	150	148.7	150	-1.3	0.13	
# 6	150	148.5	150	-1.5	0.21	
# 7	150	148.6	150	-1.4	0.14	
# 8	150	149.5	150	-0.5	0.18	
# 9	150	148.5	150	-1.5	0.13	
# 10	150	149.0	150	-1.0	0.15	
# 11	150	149.5	150	-0.5	0.24	
# 12	150	148.7	150	-1.3	0.15	

(R)

Hole No.	UUC Setting (°C)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Stability of UUC (± °C)	Uncertainty (± °C)
# 1	150	148.2	150	-1.8	0.12	0.61
# 2	150	148.0	150	-2.0	0.13	
# 3	150	148.5	150	-1.5	0.21	
# 4	150	149.0	150	-1.0	0.18	
# 5	150	149.6	150	-0.4	0.16	
# 6	150	149.3	150	-0.7	0.15	
# 7	150	148.4	150	-1.6	0.18	
# 8	150	148.6	150	-1.4	0.15	
# 9	150	148.4	150	-1.6	0.16	
# 10	150	148.6	150	-1.4	0.12	
# 11	150	149.2	150	-0.8	0.12	
# 12	150	148.5	150	-1.5	0.12	

UUC : Unit Under Calibration

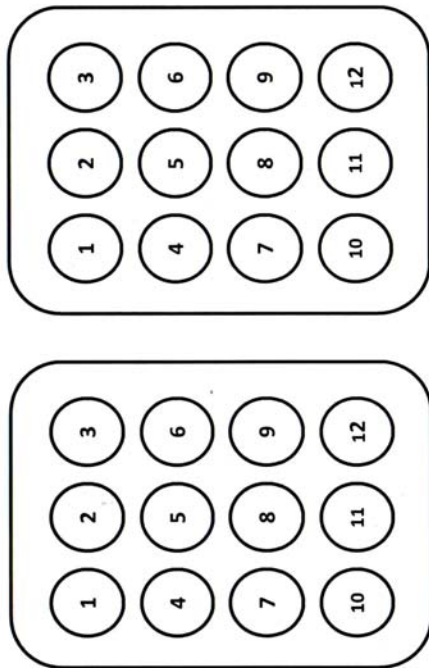
FE-169

Calibrated by Apisit  
REV.02 02/24/21

Certificate No.: TT-2103001/23

Page 4 of total 4 pages

Measurement Results (Cont.):



Front View L

Front View R

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -

FE-169

Calibrated by Apisit  
REV.02 02/24/21



## Certificate of Calibration

Certificate No. : 66-430007-1

Page : 1 of 2

Submitted by :

C.E.M Technology (Thailand) Co.,Ltd.

219/43 Moo.12 Peichkasem Rd, Omnoi, Krathumban, Samutsakorn 74130 (Head Office)

Equipment :

Digital Conductivity meter (Pocket)

Manufacturer : XS Instruments Model : PC 5

Serial No. : GB 0706/024 ID No. : WW-23-001

Environment :

On site calibration was carried out at the Laboratory C.E.M Technology (Thailand) Co.,Ltd.

Ambient Temperature (22.0 to 22.6) °C

Relative Humidity (55 to 58) %

Date of Received :

13 February 2023

Date of Calibration :

13 February 2023

Date of Issue :

18 February 2023

Calibrated by :

Bunjerd Masri

Calibration Method : In-house method CAL-M4301 direct measurement by conductivity buffer solution

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

Standard Buffer Solution

Material	Lot No.	Exp. Date	Traceability
84 µS/cm	7824	16 June 2025	National Institute of Standards and Technology (NIST), U.S.A., S.R.M.
1413 µS/cm	795891	17 February 2023	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
12.88 mS/cm	795893	14 February 2023	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025

Approved by :

(Bunjerd Masri)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

Certificate No. : 66-430007-1

Page : 2 of 2

Result of Calibration :

UUC Condition As-Received : Good

Function : Conductivity measurement

Before Adjustment

Standard Conductivity Solution	UUC Reading	Correction	Uncertainty ( ± )	Unit
84*	116.4	-32.4	1.1	µS/cm
1413	1576	-163	9.0	µS/cm
12.88	15.27	-2.39	0.082	mS/cm

After Adjustment : at 84, 1413 µS/cm 12.880, 80 mS/cm

Standard Conductivity Solution	UUC Reading	Correction	Uncertainty ( ± )	Unit
84*	84.0	0.0	1.1	µS/cm
1413	1413	0	9.0	µS/cm
12.88	12.88	0.00	0.082	mS/cm

Remark

UUC : Unit Under Calibration

\* This parameter are out of accreditation's scope.

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%

-oOo-







## THAI CALIBRATION SERVICES CO., LTD.

198 Moo 9 Soi Raikang 30 Puttamonthon 5 Rd., Sampran, Nakornpathom 73210  
Tel. 0-3439-7682-5 Fax: 0-3439-7687  
www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



NSC-TIS-TIS 17025  
CALIBRATION 0189

## CALIBRATION CERTIFICATE

Certificate No.S23031535

page 1 of 2

**Customer :** C.E.M. TECHNOLOGY (THAILAND) CO., LTD.

31/8 Moo 13 Raikang,  
Sampran, Nakornpathom 73210

**Equipment :** Non-automatic weighing instrument (Electronic instrument)

**Manufacturer :** Sartorius

**Model :** BSA224S-CW

**Order No. :** 66S0828-1

**Ambient temperature :** (24.1 ± 5.0) °C

**Relative humidity :** (47.5 ± 10.0) %

**Received date :** 03-Mar-2023

**Date of calibration :** 03-Mar-2023

**Date of issue :** 04-Mar-2023

**Condition of the balance :** Good working conditions

**Place of calibration :** กรุงเทพมหานคร

**ID No. :** CI-01-003

**Calibration method**

This instrument was calibrated according to the EURAMET Calibration Guide No. 18.

**Condition of reference standard weight**

**Instrument** **Nominal value** **Serial No.** **Certificate No.** **Due-date** **Density (kg/m<sup>3</sup>)**

1 Standard weight set 1 mg to 2 kg 15885+15849 M2210001S 8-Oct-2023 7950

**Traceability of the reference standard weight**

This certificate is traceable to SI unit through Mass Calibration Laboratory Thai Calibration Services Co., Ltd., NSC-ONSC

accredited no. Calibration 0189.

Calibrated By :

Teerawat Inanom  
Technician

Approved By :

Chonlatee Pongwatvisanon  
Approved Signatory

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except with the prior written approval of the head of TCS calibration laboratory.

TCS-F-138 Issue 01/Rev.00/2 Jul 2018

No. 05234



## THAI CALIBRATION SERVICES CO., LTD.

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www.thaical.com E-mail : sale@thaicalibration.com, lab@thaicalibration.com



NSC-TIS-TIS 17025  
CALIBRATION 0189

## CALIBRATION CERTIFICATE

Certificate No.S23031535

page 2 of 2

**The repeatability of indication**

Nominal Value ( mg )	Standard Deviation of reading ( mg )	Maximum difference between successive reading ( mg )	n
200000	0.04	0.1	5

**The effect of eccentric application of a load on the indication (test load : 100000 mg)**

Position	Balance Reading ( mg )
Point 1	100000.0
Point 2	99999.9
Point 3	100000.0
Point 4	100000.0
Point 5	100000.0
Eccentric Value	0.1



**The error of indication**

Nominal Value ( mg )	Value of Reference Standard Weight ( mg )	Balance Reading ( mg )	Correction ( mg )	Uncertainty (±) ( mg )	k
Unload	0.0	0.0	0.0	0.14	2.21
1000	1000.0	1000.0	0.0	0.14	2.20
2000	2000.0	2000.1	-0.1	0.14	2.20
5000	5000.0	5000.1	-0.1	0.14	2.18
10000	10000.0	10000.0	0.0	0.14	2.17
20000	20000.0	20000.0	0.0	0.15	2.14
50000	50000.0	50000.1	-0.1	0.15	2.11
100000	100000.0	99999.8	+0.2	0.18	2.04
120000	120000.0	119999.8	+0.2	0.22	2.00
150000	150000.0	149999.8	+0.2	0.24	2.00
200000	200000.0	199999.7	+0.3	0.27	2.00

Remark : Adjustment, Internal weight

**Uncertainty of measurement**

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor (k), which for a normal distribution corresponds to a coverage probability of approximately 95% (confidence level).

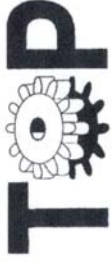
This report will certify of the calibrated equipment only.

--End--

TCS-F-138 Issue 01/Rev.00/2 Jul 2018

No. 05235





Trade & Engineering

## TSP High Volume Sampler TE-5000 TSP Sampler Verification

### Site Information

Location: -      Site ID: -      Date: 19 Oct 22  
Sampler: TE-5000 TSP      Serial No: 3281      Tech: Tong.P

### Site Conditions

Barometric Pressure (in Hg): 31.00      Corrected Pressure (mm Hg): 787.4  
Temperature (deg F): 76.0      Temperature (deg K): 297.6  
Average Press. (in Hg): 28.00      Corrected Average (mm Hg): 711.2  
Average Temp (Deg F): 75.9      Average Temp: (Deg K): 297.5

### Calibration Orifice

Make: Tisch      Qstd Slope: 1.58304  
Model: TE-5028A      Qstd Intercept: -0.01520  
Serial#: 1179      Calibration Due Date 12 December 2023

### Calibration Information

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart) (corrected)	IC	Linear Regression
1	8.30	1.863	63.0	64.17	Slope: 37.5798
2	6.50	1.650	56.0	57.04	Intercept: -5.4367
3	5.10	1.463	49.0	49.91	Corr. Coeff: 0.9986
4	4.60	1.390	46.0	46.85	
5	4.00	1.296	42.0	42.78	# of Observations: 5

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate  
IC = corrected chart response  
I = actual chart response  
m = calibrator Qstd slope  
b = calibrator Qstd intercept  
Ta = actual temperature during calibration (deg K)  
Pa = actual pressure during calibration (mm Hg)  
Tstd = 298 deg K  
Pstd = 760 mm Hg

For subsequent calculation of sampler flow:  
 $1/m[(I) \text{Sqrt}(298/Tav)(Pav/760)]-b]$

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

Inter Average I (chart): 43.0  
Average Flow Calculation m3/min  
1.252415345  
Average Flow Calculation in cfm  
44.2237051  
Sample Time (Hrs): 24.0  
Total flow in 24 hours m3/min  
1803.478097  
Total flow in 24 hours cfm  
63682.13534

NOTE: Ensure calibration orifice has been certified within 12 months of use

เอกสารการสอบเทียบเครื่องมือตรวจวัดคุณภาพอากาศในบรรยากาศ



Trade & Engineering

## TSP High Volume Sampler TE-5000 TSP Sampler Verification

### Site Information

Location: - Date: 19 Oct 22  
Sampler: TE-5000 TSP Serial No: 3279 Tech: Tong, P

### Site Conditions

Barometric Pressure (in Hg): 29.00 Corrected Pressure (mm Hg): 736.6  
Temperature (deg F): 76.0 Temperature (deg K): 297.6  
Average Press. (in Hg): 29.00 Corrected Average (mm Hg): 736.6  
Average Temp (Deg F): 77.0 Average Temp: (Deg K): 298.2

### Calibration Orifice

Make: Tisch Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date 12 December 2023

### Calibration Information

Plate or Test #	H2O (in)	Qstd (m3/min)	I IC (chart) (corrected)	Linear Regression
1	7.50	1.714	52.0	Slope: 28.0882
2	5.60	1.482	47.0	Intercept: 3.8314
3	4.40	1.315	42.0	Corr. Coeff: 0.9960
4	3.30	1.140	36.0	
5	2.70	1.032	33.0	
				# of Observations: 5

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = [I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]]$$

Qstd = standard flow rate  
IC = corrected chart response  
I = actual chart response  
m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m([I]\text{Sqrt}(298/Tav)(Pav/760))-b)$$

Inter Average I (chart): 40.1

Average Flow Calculation m3/min

1.268735746

Average Flow Calculation in cfm

44.79999045

Sample Time (Hrs): 24.0

Total flow in 24 hours m3/min

1826.979474

Total flow in 24 hours cfm

64511.98624

NOTE: Ensure calibration orifice has been certified within 12 months of use



Trade & Engineering

## TSP High Volume Sampler TE-5000 TSP Sampler Verification

### Site Information

Location: - Date: 18 Oct 22  
Sampler: TE-5000 TSP Serial No: 3277 Tech: Tong, P

### Site Conditions

Barometric Pressure (in Hg): 30.00 Corrected Pressure (mm Hg): 762.0  
Temperature (deg F): 77.0 Temperature (deg K): 298.2  
Average Press. (in Hg): 30.00 Corrected Average (mm Hg): 762.0  
Average Temp (Deg F): 78.4 Average Temp: (Deg K): 298.9

### Calibration Orifice

Make: Tisch Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date 12 December 2023

### Calibration Information

Plate or Test #	H2O (in)	Qstd (m3/min)	I IC (chart) (corrected)	Linear Regression
1	7.70	1.764	54.0	Slope: 28.8279
2	5.70	1.519	49.0	Intercept: 4.0986
3	4.60	1.366	44.0	Corr. Coeff: 0.9942
4	3.50	1.193	38.0	
5	2.90	1.086	35.0	
				# of Observations: 5

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = [I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]]$$

Qstd = standard flow rate  
IC = corrected chart response  
I = actual chart response  
m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m([I]\text{Sqrt}(298/Tav)(Pav/760))-b)$$

Inter Average I (chart): 40.1

Average Flow Calculation m3/min

1.248502955

Average Flow Calculation in cfm

44.08555575

Sample Time (Hrs): 24.0

Total flow in 24 hours m3/min

1797.844256

Total flow in 24 hours cfm

63483.20029

NOTE: Ensure calibration orifice has been certified within 12 months of use





Trade & Engineering

## TSP High Volume Sampler TE-5000 TSP Sampler Verification

### Site Information

Location: - Date: 9 Jan 23  
Sampler: TE-5000 TSP Serial No: 3267 Tech: Tong.P

### Site Conditions

Barometric Pressure (in Hg): 28.00 Corrected Pressure (mm Hg): 711.2  
Temperature (deg F): 76.0 Temperature (deg K): 297.6  
Average Press. (in Hg): 27.00 Corrected Average (mm Hg): 685.8  
Average Temp (Deg F): 75.0 Average Temp: (Deg K): 297.0

### Calibration Orifice

Make: Tisch Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date 12 December 2023

### Calibration Information

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart) (corrected)	IC	Linear Regression
1	6.80	1.604	62.2	60.21	Slope: 33.1580
2	5.00	1.377	55.5	53.73	Intercept: 7.5236
3	3.60	1.170	48.3	46.76	Corr. Coeff: 0.9980
4	3.10	1.086	45.1	43.66	
5	2.50	0.976	40.6	39.30	# of Observations: 5

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = [I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]]$$

Qstd = standard flow rate  
IC = corrected chart response  
I = actual chart response  
m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)  
Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m[(I)[\text{Sqrt}(298(Tav/Pav)(760/P))]-b]$$

Inter Average I (chart): 44.0  
Average Flow Calculation m3/min  
1.035675716  
Average Flow Calculation in cfm  
36.57046973  
Sample Time (Hrs): 24.0  
Total flow in 24 hours m3/min  
1491.373032  
Total flow in 24 hours cfm  
52661.47642

NOTE: Ensure calibration orifice has been certified within 12 months of use



Trade & Engineering

## TSP High Volume Sampler TE-5000 TSP Sampler Verification

### Site Information

Location: - Date: 9 Jan 23  
Sampler: TE-5000 TSP Serial No: 3264 Tech: Tong.P

### Site Conditions

Barometric Pressure (in Hg): 27.00 Corrected Pressure (mm Hg): 685.8  
Temperature (deg F): 75.0 Temperature (deg K): 297.0  
Average Press. (in Hg): 26.00 Corrected Average (mm Hg): 660.4  
Average Temp (Deg F): 74.2 Average Temp: (Deg K): 296.6

### Calibration Orifice

Make: Tisch Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date 12 December 2023

### Calibration Information

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart) (corrected)	IC	Linear Regression
1	6.80	1.577	62.1	59.09	Slope: 33.1580
2	5.00	1.354	55.4	52.71	Intercept: 7.2943
3	3.60	1.150	48.2	45.86	Corr. Coeff: 0.9980
4	3.10	1.068	45.0	42.82	
5	2.50	0.960	40.5	38.53	# of Observations: 5

### Calculations

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = [I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]]$$

Qstd = standard flow rate  
IC = corrected chart response  
I = actual chart response  
m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)  
Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m[(I)[\text{Sqrt}(298(Tav/Pav)(760/P))]-b]$$

Inter Average I (chart): 44.0  
Average Flow Calculation m3/min  
1.019916094  
Average Flow Calculation in cfm  
36.01398589  
Sample Time (Hrs): 24.0  
Total flow in 24 hours m3/min  
1468.679175  
Total flow in 24 hours cfm  
51860.13967

NOTE: Ensure calibration orifice has been certified within 12 months of use





## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 4 October 2022  
Sampler: TE-6070 PM10 Serial No: 3310 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 29.47 Corrected Pressure (mm Hg): 760.1  
Temperature (deg F): 77.0 Temperature (deg K): 298.0  
Average Press. (in Hg): 28.70 Corrected Average (mm Hg): 761.3  
Average Temp. (deg F): 77.1 Average Temp. (deg K): 298.1

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression	# of Observations:
1	7.60	1.100	57.0	35.69	Slope 32.3375	5
2	5.80	0.962	51.0	31.93	Intercept 0.5255	
3	4.60	0.858	46.0	28.80	Corr. Coeff 0.9972	
4	3.80	0.781	41.0	25.67	SFR 1.132	
5	2.80	0.671	35.0	21.91	SSP 59.28	

### Calculations

$Qa = 1/m(\sqrt{(H2O)(Ta/Pa)}) - b$   
 $IC = I(\sqrt{(Ta/Pa)})$   
 $m = \text{sampler slope}$   
 $b = \text{sampler intercept}$   
 $I = \text{chart response}$   
 $Tav = \text{daily average temperature}$   
 $Pav = \text{daily average pressure}$

Average I (chart): 55.6  
Average Flow over Sample (m3/min): 1.059570151  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min): 1525.781017  
Total flow over sample (CFM): 53875.32771

NOTE: Ensure calibration orifice has been certified within 12 months of use



## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 4 October 2022  
Sampler: TE-6070 PM10 Serial No: 3286 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 27.00 Corrected Pressure (mm Hg): 760.1  
Temperature (deg F): 77.6 Temperature (deg K): 298.3  
Average Press. (in Hg): 30.00 Corrected Average (mm Hg): 761.2  
Average Temp. (deg F): 77.9 Average Temp. (deg K): 298.5

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression	# of Observations:
1	7.50	1.093	56.0	35.08	Slope 31.5206	5
2	5.90	0.971	51.0	31.95	Intercept 0.9099	
3	4.60	0.858	45.0	28.19	Corr. Coeff 0.9973	
4	3.80	0.781	40.0	25.06	SFR 1.131	
5	2.90	0.684	36.0	22.55	SSP 58.36	

### Calculations

$Qa = 1/m(\sqrt{(H2O)(Ta/Pa)}) - b$   
 $IC = I(\sqrt{(Ta/Pa)})$   
 $m = \text{sampler slope}$   
 $b = \text{sampler intercept}$   
 $I = \text{chart response}$   
 $Tav = \text{daily average temperature}$   
 $Pav = \text{daily average pressure}$

Average I (chart): 55.4  
Average Flow over Sample (m3/min): 1.071752758  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min): 1543.323972  
Total flow over sample (CFM): 54494.76945

NOTE: Ensure calibration orifice has been certified within 12 months of use



## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 10 January 2023  
Sampler: TE-6070 PM10 Serial No: 3275 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 26.90 Corrected Pressure (mm Hg): 683.3  
Temperature (deg F): 75.4 Temperature (deg K): 297.1  
Average Press. (in Hg): 26.40 Corrected Average (mm Hg): 670.6  
Average Temp. (deg F): 75.0 Average Temp. (deg K): 296.9

### Calibration Orifice

Make: Tisch Environmental, Inc.  
Model: TE-5028A Qstd Slope: 1.58304  
Serial#: 1179 Qstd Intercept: -0.01520  
Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression	# of Observations:
1	9.50	1.294	60.6	39.96	Slope 35.6263	5
2	7.70	1.166	55.6	36.66	Intercept -5.4804	
3	6.50	1.072	50.6	33.37	Corr. Coeff 0.9939	
4	5.70	1.004	45.5	30.00	SFR 1.110	
5	4.50	0.893	39.4	25.98	SSP 51.65	

### Calculations

$$Qa = 1/m(\sqrt{(H_2O)(Ta/Pa)})-b$$
$$IC = I(\sqrt{(Ta/Pa)})$$

m = sampler slope  
b = sampler intercept  
I = chart response

Tav = daily average temperature  
Pav = daily average pressure

Qa = actual flow rate  
IC = corrected chart response  
m = sampler slope

b = sampler intercept

Ta = actual temperature (deg K)

Pa = actual pressure (mm Hg)

Ts = Average temperature (deg K)

Ps = Average pressure (mm Hg)

NOTE: Ensure calibration orifice has been certified within 12 months of use

Average I (chart): 52.3  
Average Flow over Sample (m3/min): 1.130638789  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min): 1628.119856  
Total flow over sample (CFM): 57488.9121



## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 10 January 2023  
Sampler: TE-6070 PM10 Serial No: 3260 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 27.00 Corrected Pressure (mm Hg): 685.8  
Temperature (deg F): 75.5 Temperature (deg K): 297.2  
Average Press. (in Hg): 26.40 Corrected Average (mm Hg): 670.6  
Average Temp. (deg F): 75.0 Average Temp. (deg K): 296.9

### Calibration Orifice

Make: Tisch Environmental, Inc.  
Model: TE-5028A Qstd Slope: 1.58304  
Serial#: 1179 Qstd Intercept: -0.01520  
Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression	# of Observations:
1	8.10	1.193	59.2	38.97	Slope 31.6154	5
2	6.30	1.053	54.2	35.68	Intercept 1.8101	
3	5.10	0.949	49.2	32.39	Corr. Coeff 0.9952	
4	4.30	0.872	44.1	29.03	SFR 1.106	
5	3.10	0.742	38.0	25.01	SSP 55.87	

### Calculations

$$Qa = 1/m(\sqrt{(H_2O)(Ta/Pa)})-b$$
$$IC = I(\sqrt{(Ta/Pa)})$$

m = sampler slope  
b = sampler intercept  
I = chart response

SFR = sampler set point flow rate  
SSP = sampler chart set point

m = sampler slope

b = sampler intercept

Ta = actual temperature (deg K)

Pa = actual pressure (mm Hg)

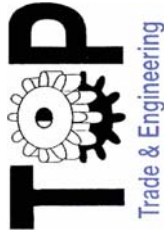
Ts = Average temperature (deg K)

Ps = Average pressure (mm Hg)

NOTE: Ensure calibration orifice has been certified within 12 months of use

Average I (chart): 53.1  
Average Flow over Sample (m3/min): 1.060313912  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min): 1526.852034  
Total flow over sample (CFM): 53913.14532





## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 2 October 2023  
Sampler: TE-6070 PM10 Serial No: 3115 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 26.60 Corrected Pressure (mm Hg): 675.6  
Temperature (deg F): 75.3 Temperature (deg K): 297.1  
Average Press. (in Hg): 26.65 Corrected Average (mm Hg): 676.9  
Average Temp. (deg F): 76.5 Average Temp. (deg K): 297.7

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart) (corrected)	IC	Linear Regression	# of Observations:
1	9.80	1.321	60.5	40.12	Slope 33.7625	5
2	7.35	1.145	55.7	36.93	Intercept -3.3283	
3	6.60	1.086	50.8	33.68	Corr. Coeff 0.9758	
4	5.35	0.978	45.5	30.17	SFR 1.130	
5	4.60	0.908	39.3	26.06	SSP 52.50	

### Calculations

$$Qa = 1/m(\sqrt{(H2O)(Ta/Pa)})-b$$
$$IC = I(\sqrt{(Ta/Pa)})$$

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

Qa = actual flow rate  
IC = corrected chart response  
m = sampler slope  
b = sampler intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
Ts = Average temperature (deg K)  
Ps = Average pressure (mm Hg)

Average I (chart): 50.4  
Average Flow over Sample (m3/min): 1.088579793  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min): 1567.554902  
Total flow over sample (CFM): 55350.36359

NOTE: Ensure calibration orifice has been certified within 12 months of u



## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 10 January 2023  
Sampler: TE-6070 PM10 Serial No: 1313 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 28.10 Corrected Pressure (mm Hg): 713.7  
Temperature (deg F): 76.2 Temperature (deg K): 297.6  
Average Press. (in Hg): 27.00 Corrected Average (mm Hg): 685.8  
Average Temp. (deg F): 75.4 Average Temp. (deg K): 297.1

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart) (corrected)	IC	Linear Regression	# of Observations:
1	8.80	1.220	59.9	38.68	Slope 33.6928	5
2	7.00	1.089	54.9	35.45	Intercept -1.8198	
3	5.80	0.992	49.9	32.22	Corr. Coeff 0.9945	
4	5.00	0.922	44.8	28.93	SFR 1.087	
5	3.80	0.805	38.7	24.99	SSP 53.92	

### Calculations

$$Qa = 1/m(\sqrt{(H2O)(Ta/Pa)})-b$$
$$IC = I(\sqrt{(Ta/Pa)})$$

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

Qa = actual flow rate  
IC = corrected chart response  
m = sampler slope  
b = sampler intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
Ts = Average temperature (deg K)  
Ps = Average pressure (mm Hg)

Average I (chart): 34.5  
Average Flow over Sample (m3/min): 0.727985358  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min): 1048.298915  
Total flow over sample (CFM): 37015.43469

NOTE: Ensure calibration orifice has been certified within 12 months of u



# Certificate of Analyzer Performance Testing

Calibrated Date : 21-Jan-23 Certificate No. : 0123-003 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : CO Analyzer  
 Model : 48C  
 Manufacturer : Thermo Environmental  
 Serial No. : 71021-367

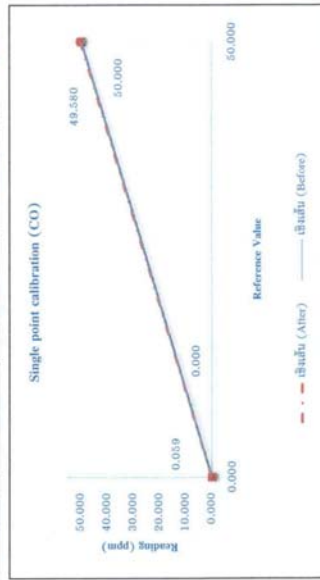
**Environmental**  
 Temperature : 26.4 °C  
 Humidity : 52.7 %RH

**Calibrator System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO2 Conc. : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

## Calibration Check

Gas	Zero				Span			
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)		Reading Value (ppm)	Expected Value (ppm)	Drift (%)	
CO	Before							
	0.039	0.000	0.00		49.580	50.000	-0.84	
CO	After							
	0.000	0.000	0.00		50.000	50.000	0.00	



Calibrated by : *Tong Pima*  
(Mr. Tong Pima)

# Certificate of Analyzer Performance Testing

Calibrated Date : 10-Jun-23 Certificate No. : 0023-001 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : CO Analyzer  
 Model : 48C  
 Manufacturer : Thermo Environmental  
 Serial No. : 508011068

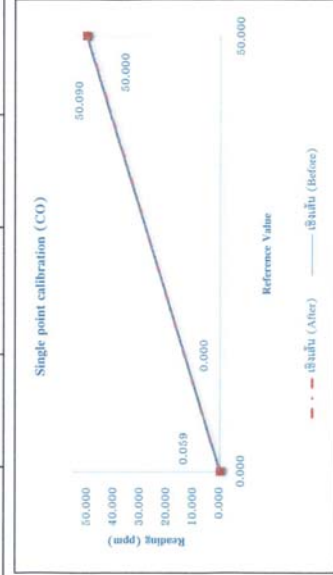
**Environmental**  
 Temperature : 25.2 °C  
 Humidity : 51.3 %RH

**Calibrator System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO2 Conc. : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

## Calibration Check

Gas	Zero				Span			
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)		Reading Value (ppm)	Expected Value (ppm)	Drift (%)	
CO	Before							
	0.039	0.000	0.06		50.1	50.000	0.18	
CO	After							
	0.000	0.000	0.00		50.0	50.000	0.00	



Calibrated by : *Tong Pima*  
(Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23 Certificate No. : 0823-003 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : CO Analyzer  
 Model : 48C  
 Manufacturer : Thermo Environmental  
 Serial No. : 508011069

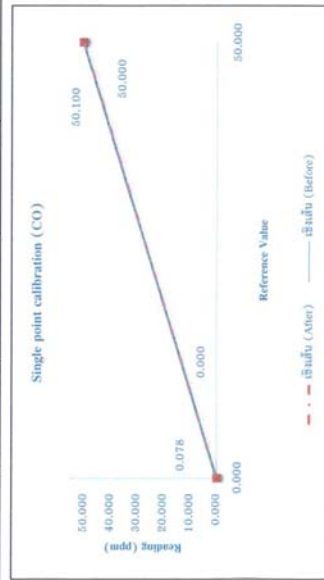
**Environmental**  
 Temperature : 25.5 °C  
 Humidity : 53.7 %RH

**Calibration System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO2 Conc. : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
CO	Before			After		
	0.076	0.080	0.08	50.1	50.000	0.20
CO	Before			After		
	0.000	0.000	0.00	50.0	50.000	0.00



Calibrated by : *Thp.*  
 (Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 1-Apr-23 Certificate No. : 0423-001 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : CO Analyzer  
 Model : 48C  
 Manufacturer : Thermo Environmental  
 Serial No. : 401304261

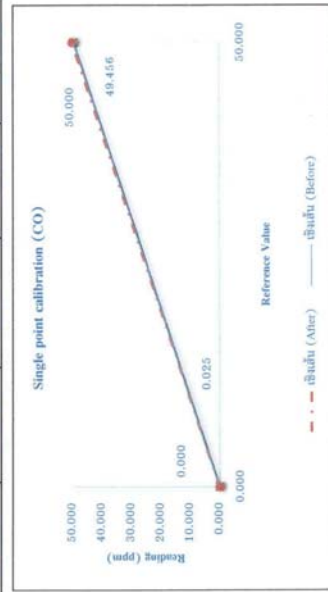
**Environmental**  
 Temperature : 25.2 °C  
 Humidity : 52.3 %RH

**Calibration System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO2 Conc. : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
CO	Before			After		
	0.025	0.000	0.03	49.456	50.000	-1.09
CO	Before			After		
	0.000	0.000	0.00	50.000	50.000	0.00



Calibrated by : *Thp.*  
 (Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 22-Jul-23 Certificate No. : 0723-001 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : CO Analyzer  
 Model : 48C  
 Manufacturer : Thermo Environmental  
 Serial No. : 508011061

**Environmental**  
 Temperature : 24.2 °C  
 Humidity : 52.0 %RH

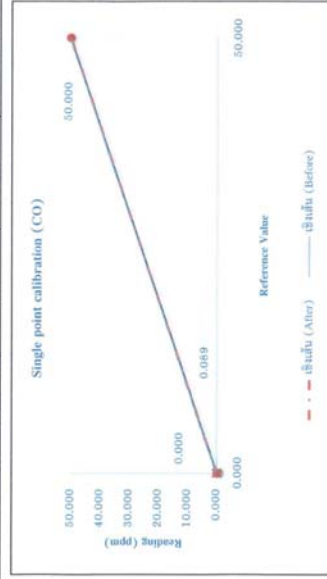
### Calibration System

**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811438  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO2 Conc. : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
CO	0.089	0.090	0.09	Before		
				50.2	50.000	0.40
CO	0.000	0.000	0.00	After		
				50.0	50.000	0.00



Calibrated by : *Tanjar*  
 (Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 1-Apr-23 Certificate No. : 0423-003 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : SO2 Analyzer  
 Model : 43C  
 Manufacturer : Thermo Environmental  
 Serial No. : 60858-364

**Environmental**  
 Temperature : 25.2 °C  
 Humidity : 52.3 %RH

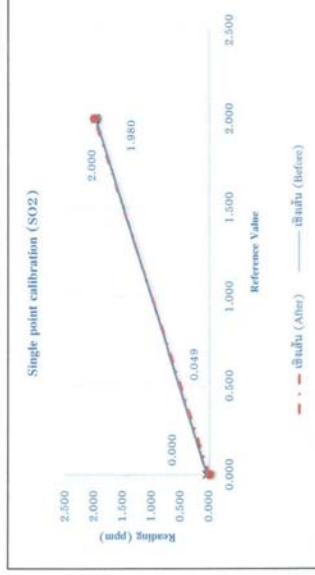
### Calibration System

**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811438  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO2 Conc. : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
SO2	0.049	0.050	0.05	Before		
				1.98	2.000	-1.00
SO2	0.000	0.000	0.00	After		
				2.00	2.000	0.00



Calibrated by : *Tanjar*  
 (Mr. Tong Pima)



## Certificate of Analyzer Performance Testing

Calibrated Date : 5-Aug-23 Certificate No. : 0823-001 Page : 1/1

### Analyzer Instruments

Analyzer Type : SO2 Analyzer Manufacturer : Thermo Environmental  
Model : 43C Serial No. : 43C-62201-334

Environmental  
Temperature : 25.0 °C  
Humidity : 51.9 %RH

### Calibrator System

#### Calibrator Units

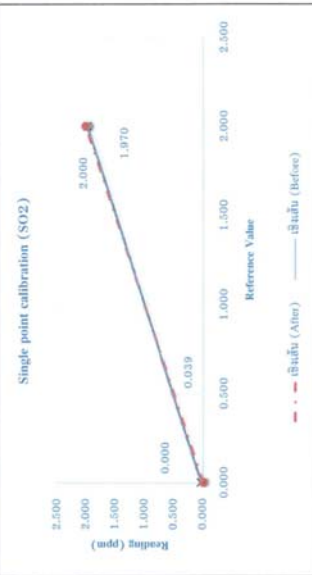
Gas Calibration : Thermo Environmental Zero Air Generator : API  
Model : 146C Model : 701  
Serial No. : 514811458 Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm Cylinder No. : CC750227  
SO2 Conc. : 2 ppm Expire Date : 21-Nov-23  
CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
SO2	Before					
	0.0339	0.000	0.04	1.97	2.000	-1.50
SO2	After					
	0.000	0.000	0.00	2.00	2.000	0.00



Calibrated by : *Taylor*  
(Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 1-Sep-22 Certificate No. : 0922-001 Page : 1/1

### Analyzer Instruments

Analyzer Type : SO2 Analyzer Manufacturer : Thermo Environmental  
Model : 43C Serial No. : 70852-367

Environmental  
Temperature : 25.2 °C  
Humidity : 52.0 %RH

### Calibrator System

#### Calibrator Units

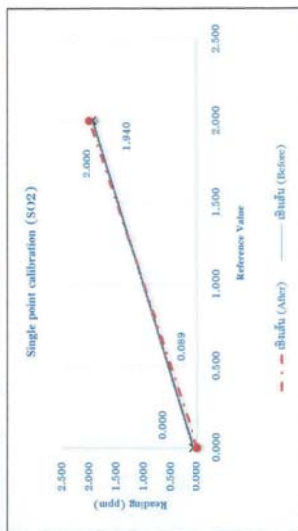
Gas Calibration : Thermo Environmental Zero Air Generator : API  
Model : 146C Model : 701  
Serial No. : 514811458 Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm Cylinder No. : CC750227  
SO2 Conc. : 2 ppm Expire Date : 21-Nov-23  
CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
SO2	Before					
	0.089	0.000	0.09	1.94	2.000	-3.00
SO2	After					
	0.000	0.000	0.00	2.00	2.000	0.00



Calibrated by : *Taylor*  
(Mr. Tong Pima)

# Certificate of Analyzer Performance Testing

Calibrated Date : 4-Aug-23 Certificate No. : 0823-003 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : NO/NO/NOx Analyzer  
 Model : 42C  
 Manufacturer : Thermo Environmental  
 Serial No. : 59406-323

**Environmental**  
 Temperature : 26.3 °C  
 Humidity : 42.5 %RH

**Calibration System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458

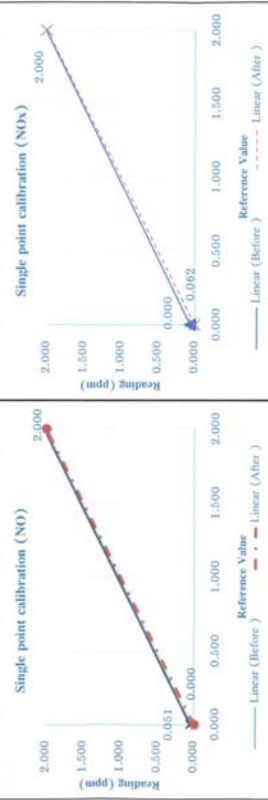
**Standard Gas**  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

NO Conc. : 2 ppm  
 SO2 : 2 ppm  
 CO Conc. : 50 ppm

## Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
NO	0.031	0.000	0.05	2.03	2.00	1.50
	0.062	0.000	0.06	2.01	2.00	0.50
NOx	0.000	0.000	0.00	2.00	2.00	0.00
	0.000	0.000	0.00	2.00	2.00	0.00



Calibrated by : *Top*  
(Mr. Tong Pima)

# Certificate of Analyzer Performance Testing

Calibrated Date : 4-Jul-23 Certificate No. : 0723-001 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : NO/NO/NOx Analyzer  
 Model : 42C  
 Manufacturer : Thermo Environmental  
 Serial No. : 63470-339

**Environmental**  
 Temperature : 25.1 °C  
 Humidity : 40.4 %RH

**Calibration System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458

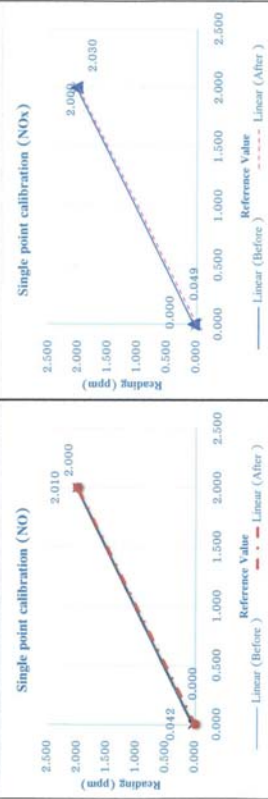
**Standard Gas**  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

NO Conc. : 2 ppm  
 SO2 : 2 ppm  
 CO Conc. : 50 ppm

## Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
NO	0.042	0.000	0.04	2.01	2.00	0.50
	0.049	0.000	0.05	2.03	2.00	1.50
NOx	0.000	0.000	0.00	2.00	2.00	0.00
	0.000	0.000	0.00	2.00	2.00	0.00



Calibrated by : *Top*  
(Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 11-Mar-23 Certificate No. : 0323-003 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : NO/NO<sub>x</sub>/NO<sub>x</sub> Analyzer  
 Model : 42C  
 Manufacturer : Thermo Environmental  
 Serial No. : 58926-320

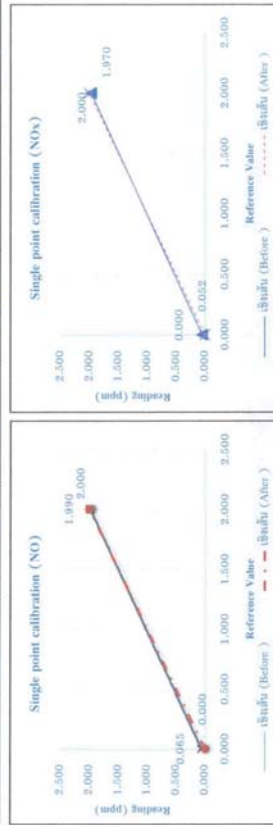
**Environmental**  
 Temperature : 24.3 °C  
 Humidity : 51.4 %RH

**Calibration System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811438  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO<sub>2</sub> : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
NO	0.065	0.000	0.07	1.99	2.00	-0.50
NO <sub>x</sub>	0.052	0.000	0.05	1.97	2.00	-1.50
After						
NO	0.000	0.000	0.00	2.00	2.00	0.00
NO <sub>x</sub>	0.000	0.000	0.00	2.00	2.00	0.00



Calibrated by : *Tayfun*  
 (Mr. Teog Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23 Certificate No. : 0823-001 Page : 1/1

**Analyzer Instruments**  
 Analyzer Type : NO/NO<sub>x</sub>/NO<sub>x</sub> Analyzer  
 Model : 42C  
 Manufacturer : Thermo Environmental  
 Serial No. : 66193-351

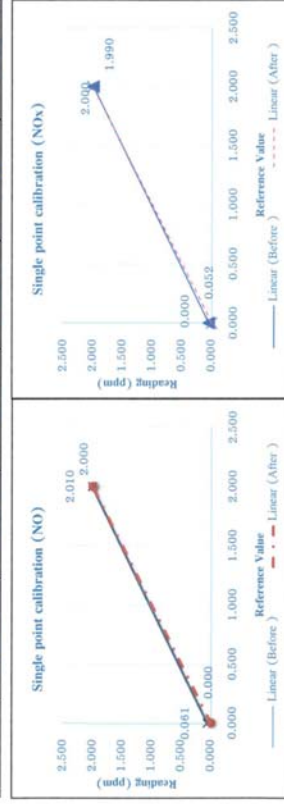
**Environmental**  
 Temperature : 25.3 °C  
 Humidity : 40.2 %RH

**Calibration System**  
**Calibrator Units**  
 Gas Calibration : Thermo Environmental  
 Model : 146C  
 Serial No. : 514811458  
 Zero Air Generator : API  
 Model : 701  
 Serial No. : 179

**Standard Gas**  
 NO Conc. : 2 ppm  
 SO<sub>2</sub> : 2 ppm  
 CO Conc. : 50 ppm  
 Cylinder No. : CC750227  
 Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
NO	0.061	0.000	0.06	2.01	2.00	0.50
NO <sub>x</sub>	0.052	0.000	0.05	1.99	2.00	-0.50
After						
NO	0.000	0.000	0.00	2.00	2.00	0.00
NO <sub>x</sub>	0.000	0.000	0.00	2.00	2.00	0.00



Calibrated by : *Tayfun*  
 (Mr. Teog Pima)



## Certificate of Analyzer Performance Testing

Calibrated Date : 30-Jan-23 Certificate No. : 0123-001  
Page : 1/1

**Analyzer Instruments**  
Analyzer Type : THC Analyzer Manufacturer : Thermo Environmental  
Model : 51 Serial No. : 51HT-73244-373

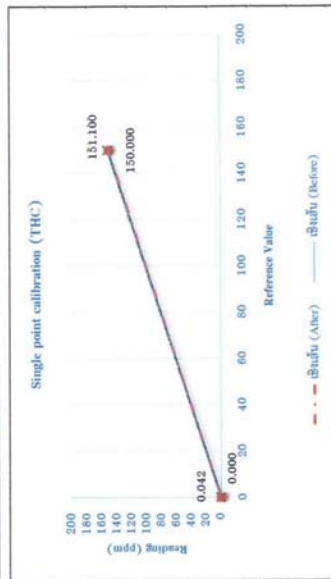
**Environmental**  
Temperature : 24.7 °C  
Humidity : 54.4 %RH

### Calibration System

**Calibrator Units**  
Gas Calibration : Thermo Environmental Zero Air Generator : API  
Model : 146C Model : 701  
Serial No. : 514811458 Serial No. : 179  
**Standard Gas**  
Propane Conc. : 150 ppm Cylinder No. : 21W281046  
Expire Date : 26-Sep-25

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
THC	0.042	0.000	0.042	151	150	0.733
THC	0.000	0.000	0.000	150	150	0.000



Calibrated by : *Taylor*  
(Mr. Tong Pima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 30-Jan-23 Certificate No. : 0123-002  
Page : 1/1

**Analyzer Instruments**  
Analyzer Type : THC Analyzer Manufacturer : Baseline  
Model : Series 8600 Serial No. : 584

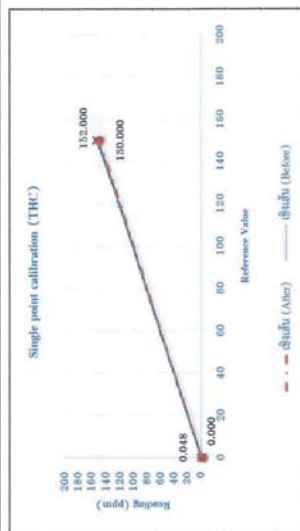
**Environmental**  
Temperature : 24.5 °C  
Humidity : 56.3 %RH

### Calibration System

**Calibrator Units**  
Gas Calibration : Thermo Environmental Zero Air Generator : API  
Model : 146C Model : 701  
Serial No. : 514811458 Serial No. : 179  
**Standard Gas**  
Propane Conc. : 150 ppm Cylinder No. : 21W281046  
Expire Date : 26-Sep-25

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
THC	0.048	0.000	0.048	152	150	1.333
THC	0.000	0.000	0.000	150	150	0.000



Calibrated by : *Taylor*  
(Mr. Tong Pima)

เอกสารการสอบเทียบเครื่องมือตรวจวัดระดับเสียงในบรรยากาศ

Certificate of Calibration

EQUIPMENT	:	SOUND LEVEL METER
MANUFACTURER	:	ACO
MODEL	:	TYPE 6226
SERIAL No.	:	150009
ID No.	:	CEM-SI-09
SUBMITTED BY	:	C.E.M TECHNOLOGY (THAILAND) CO.,LTD. 219/43 MOO 12, PETCHKASEM RD., OMNOI, KRATHUMBAN SAMUTSAKORN 74130
CALIBRATED BY	:	<div>Surawit K. SURAWIT K.</div>
CALIBRATION DATE	:	9-May-23
APPROVED BY	:	<div>Dongorn (Co.) DHUDIT P.</div>
ISSUED DATE	:	9-May-23

## Calibration Report

**EQUIPMENT** : SOUND LEVEL METER  
**MANUFACTURER** : ACO  
**MODEL** : TYPE 6226  
**ID No.** : CEM-SI-09  
**RECEIVED DATE** : 4-May-23  
**AMBIENT TEMPERATURE** : 22 °C ± 3 °C  
**RELATIVE HUMIDITY** : 50%RH ± 20%RH

**SERIAL NUMBER** : 150009

**CALIBRATION DATE** : 9-May-23

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2:2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR.  
 THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR FROM CUSTOMER AT 114 Hz BEFORE CALIBRATION.

2. REFERENCE STANDARD INSTRUMENTS :-

**INSTRUMENT** : 1986  
**MODEL** : 01827  
**SERIAL No.** : EEL.BP.55/0974  
**CERTIFICATE No.** :  
**DUE DATE** : 12-Jan-24

1) MULTIFUNCTION  
 SOUND CALIBRATOR.

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

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

5. THIS CERTIFICATE IS TRACEABLE TO :-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR).

### RESULT OF CALIBRATION :

WITHOUT ADJUSTMENT

#### 1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-16.10	-15.80	-0.30	0.50
250.00	-8.60	-8.10	-0.50	0.50
500.00	-3.20	-3.0	-0.20	0.50
1000.00	0.00	0.00	0.0	0.50
2000.00	1.20	0.90	0.3	0.50

#### 2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-0.20	0.1	-0.3	0.50
250.00	0.00	0.5	-0.5	0.50
500.00	0.00	0.3	-0.3	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	-0.20	-0.4	0.2	0.50

#### 3. SOUND LEVEL LINEARITY TEST AT 1000 Hz

STANDARD APPLIED (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
74	74.0	0.0	0.50
84	84.0	0.0	0.50
94	94.0	0.0	0.50
104	104.1	-0.1	0.50
114	114.2	-0.2	0.50

UUC\* : UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

## Certificate of Calibration

**EQUIPMENT** : SOUND LEVEL METER  
**MANUFACTURER** : ACO  
**MODEL** : TYPE 6226  
**SERIAL No.** : 090057  
**ID No.** : CEM-SI-02  
**SUBMITTED BY** : C.E.M TECHNOLOGY (THAILAND) CO.,LTD.  
 219/43 MOO 12, PETCHKASEM RD., OMNOI,  
 KRATHUMBAN SAMUTSAKORN 74130

**CALIBRATED BY**

9-May-23

**CALIBRATION DATE**

**APPROVED BY**

**ISSUED DATE**

9-May-23



Calibration Report

EQUIPMENT : SOUND LEVEL METER  
MANUFACTURER : ACO  
MODEL : TYPE 6226  
ID No. : CEM-SI-02  
RECEIVED DATE : 4-May-23  
AMBIENT TEMPERATURE : 22 °C ± 3°C  
RELATIVE HUMIDITY : 50%RH ± 20%RH

SERIAL NUMBER : 090057

CALIBRATION DATE : 9-May-23

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2:2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR.  
THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR FROM CUSTOMER AT 114 Hz BEFORE CALIBRATION.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT MODEL SERIAL No. CERTIFICATE No. DUE DATE  
1) MULTIFUNCTION 1986 01827 EEL BP 55/0974 12-Jan-24  
SOUND CALIBRATOR.

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

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

5. THIS CERTIFICATE IS TRACEABLE TO :-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR).

RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-16.10	-15.80	-0.30	0.50
250.00	-8.60	-8.10	-0.50	0.50
500.00	-3.20	-3.0	-0.20	0.50
1000.00	0.00	0.00	0.0	0.50
2000.00	1.20	0.90	0.3	0.50

2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-0.20	0.1	-0.3	0.50
250.00	0.00	0.5	-0.5	0.50
500.00	0.00	0.3	-0.3	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	-0.20	-0.4	0.2	0.50

3. SOUND LEVEL LINEARITY TEST AT 1000 Hz

STANDARD APPLIED (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
74	74.0	0.0	0.50
84	84.0	0.0	0.50
94	94.0	0.0	0.50
104	104.1	-0.1	0.50
114	114.2	-0.2	0.50

UUC\* : UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

Certificate of Calibration

EQUIPMENT : SOUND LEVEL METER  
MANUFACTURER : ACO  
MODEL : TYPE 6226  
SERIAL No. : 060209  
ID No. : CEM-SI-01  
SUBMITTED BY : C.E.M TECHNOLOGY (THAILAND) CO.,LTD.  
219/43 MOO 12, PETCHKASEM RD., OMNOI,  
KRATHUMBAN SAMUTSAKORN 74130

CALIBRATED BY

9-May-23

CALIBRATION DATE

APPROVED BY

ISSUED DATE

9-May-23

## Calibration Report

**EQUIPMENT** : SOUND LEVEL METER  
**MANUFACTURER** : ACO  
**MODEL** : TYPE 6226  
**SERIAL NUMBER** : 060209  
**ID No.** : CEM-SI-01  
**RECEIVED DATE** : 4-May-23  
**CALIBRATION DATE** : 9-May-23  
**AMBIENT TEMPERATURE** : 22 °C ± 3°C  
**RELATIVE HUMIDITY** : 50%RH ± 20%RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2:2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR.  
 THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR FROM CUSTOMER AT 114 Hz BEFORE CALIBRATION.  
 2. REFERENCE STANDARD INSTRUMENTS :

**INSTRUMENT** : 1) MULTIFUNCTION SOUND CALIBRATOR.  
**MODEL** : 1986  
**SERIAL No.** : 01827  
**CERTIFICATE No.** : EEL BP.55/0974  
**DUE DATE** : 12-Jan-24

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
 4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
 5. THIS CERTIFICATE IS TRACEABLE TO :-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR).

### RESULT OF CALIBRATION :

WITHOUT ADJUSTMENT

1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE				
FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-16.10	-15.80	-0.30	0.50
250.00	-8.60	-8.10	-0.50	0.50
500.00	-3.20	-3.0	-0.20	0.50
1000.00	0.00	0.00	0.0	0.50
2000.00	1.20	0.90	0.3	0.50
2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE				
FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-0.20	0.1	-0.3	0.50
250.00	0.00	0.5	-0.5	0.50
500.00	0.00	0.3	-0.3	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	-0.20	-0.4	0.2	0.50
3. SOUND LEVEL LINEARITY TEST AT 1000 Hz				
STANDARD APPLIED (dB)		UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
74		74.0	0.0	0.50
84		84.0	0.0	0.50
94		94.0	0.0	0.50
104		104.1	-0.1	0.50
114		114.2	-0.2	0.50

UUC\* : UNIT UNDER CALIBRATION  
 THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%

END OF CALIBRATION REPORT



**FORTH**  
 CALIBRATION & SERVICE CO., LTD.  
 305/47 Soi Ramintra 123, Ramintra Rd., Minburi, Minburi, Bangkok 10510  
 Tel. 0-2948-6668, 0-2517-6650-1 Fax. 0-2517-6674  
 E-mail: forthcalibration@gmail.com  
 www.forthcal.com



## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0330-6 Job No. : 66S0330 Page : 1 of 2

**Customer** : C.E.M Technology (Thailand) Co.,Ltd.  
**Address** : 31/9 Moo 13, Raikhing, Samphran, Nakhornpathom 73210  
**Location** : Laboratory

**Equipment** : Sound Level Meter **Ambient temperature** : ( 20 ± 2 ) °C  
**Manufacturer** : Scarlet Tech **Relative humidity** : ( 50 ± 15 ) %  
**Model** : ST-11D **Atmospheric pressure** : -  
**Serial No.** : 890891 **Date of received** : 08-Mar-2023  
**Identity No.** : NS-12-002 **Date of calibration** : 10-Mar-2023  
**Range** : See to Data **Date of issued** : 13-Mar-2023

**Calibration Method** : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

### Reference Standard Instruments :

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

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

- National Institute of Metrology Thailand. (NIMT).

**Calibrated By** : Mr. Boonyarit Auejirakarn  
**Approved By** : [Signature]  
**Reviewed By** : [Signature]  
 [Signature] Ms. Natthaparakarn Thammaphan  
 [Signature] Mr. Boonyarit Auejirakarn

The reported expanded uncertainty is based on uncertainty multiplied by a coverage factor k = 2, providing a level of confidence approximately 95%. This result relates only to the item calibrated. The certificate shall not be reproduced except in full, without the written approval of the calibration director.

Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting (dB)	UUC Reading (dB)	Error Value (dB)	Uncertainty (+/-dB)
A	94	94.0	0.0	0.20
	104	104.0	0.0	0.20
	114	114.0	0.0	0.20
B	94	94.4	0.4	0.20
	104	104.0	0.0	0.20
	114	113.8	-0.2	0.20
Z	94	94.0	0.0	0.20
	104	104.0	0.0	0.20
	114	113.8	-0.2	0.20

UUC\* = Unit Under Calibration

- The End -

## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0330-7

Job No. : 66S0330

Page : 1 of 2

Customer : C.E.M Technology (Thailand) Co.,Ltd.

Address : 31/9 Moo 13, Raikhing, Samphran,

Nakhornpathom 73210

Location : Laboratory

Equipment : Sound Level Meter Ambient temperature :  $(20 \pm 2) ^\circ\text{C}$   
 Manufacturer : Scarlet Tech Relative humidity :  $(50 \pm 15) \%$   
 Model : ST-11D Atmospheric pressure : -  
 Serial No. : 820388 Date of received : 08-Mar-2023  
 Identity No. : NS-12-001 Date of calibration : 10-Mar-2023  
 Range : See to Data Date of issued : 13-Mar-2023

Calibration Method : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

### Reference Standard Instruments :

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

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

- National Institute of Metrology Thailand. (NIMT).

Calibrated By : Mr. Boonyarit Auejirakarn

Approved By :

Reviewed By : | Mr. Sompong Srisert

| Ms. Natthaparakarn Thammaphan

| Ms. Bhacharin Phanangkaew (MD)

| Mr. Boonyarit Auejirakarn



Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting (dB)	UUC Reading (dB)	Error Value (dB)	Uncertainty (+/-dB)
A	94	94.3	0.3	0.20
	104	104.3	0.3	0.20
	114	114.2	0.2	0.20
B	94	94.0	0.0	0.20
	104	103.8	-0.2	0.20
	114	113.6	-0.4	0.20
Z	94	94.3	0.3	0.20
	104	103.8	-0.2	0.20
	114	113.6	-0.4	0.20

UUC\* = Unit Under Calibration

- The End -

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0714

MTC No. EEL. BP. 77/0865

## CALIBRATION CERTIFICATE

Submitted by : C.E.M. TECHNOLOGY (THAILAND) CO., LTD.

Address : 31/8 Moo. 13 Raikhing Samphan Nakhonparthom 73210.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

### Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : BSWA

Model : BSWA 309

Serial No. : 590101 (NS-04-002)

Microphone : MP309 No.395615

Preamplifier : BSWA MA231T No.590614

### Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

### Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 24 Aug. 2022

Date of Calibration : 19-21 Sep. 2022

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### Head Office

35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tammy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa IPA-303A S/N 2212.

#### Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 19-21 Sep. 2022

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FM.BLMTC.002 Rev.4

#### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	Before adjust	After adjust				
113.91	113.7	113.9	0.0	1.0	0.30	N/A

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

#### 2. Self-generated noise

##### 2.1 Normal test

Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
19.3	0.10	N/A

##### 2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency	Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Weighting			
A-Weight	10.1	0.10	N/A
C-Weight	14.6	0.10	N/A
Flat	20.9	0.10	N/A

Date of Calibration : 19-21 Sep. 2022

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0714

MTC No. EEL. BP. 77/0865

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight			
125	0.0	0.1	1.5	0.45	0.6
1 000	-0.4	-0.4	1.0	0.45	0.6
8 000	-0.6	-0.6	5.0	0.45	0.7

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight			
63	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	1.5	0.20	0.6
250	-0.1	0.0	1.5	0.20	0.6
500	-0.1	0.0	1.5	0.20	0.6
1 000	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	2.0	0.20	0.6
4 000	-0.1	-0.1	3.0	0.20	0.6
8 000	-0.5	-0.5	5.0	0.20	0.7

Date of Calibration : 19-21 Sep. 2022

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Request No. 21-65/0714

MTC No. EEL. BP. 77/0865

### 5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

### 6. Frequency and time weightings at 1 kHz

#### 6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

#### 6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 19-21 Sep. 2022

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Request No. 21-65/0714

MTC No. EEL. BP. 77/0865

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3

Date of Calibration : 19-21 Sep. 2022

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Request No. 21-65/0714

MTC No. EEL. BP. 77/0865

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
49	48.9	-0.1	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	29.1	0.1	1.1	0.30	0.3
28	28.1	0.1	1.1	0.30	0.3
27	27.1	0.1	1.1	0.30	0.3
26	26.1	0.1	1.1	0.30	0.3
25	25.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
23-135	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 19-21 Sep. 2022

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**8. Level linearity including the level range control**

At reference level at 5 dB greater than the signal level that first clause an indication of under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
23-135	28.0	28.0	0.0	1.1	0.30	0.3

**9. Tone burst response**

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	131.0	0.0	±1.0	0.20	0.3
	2	113.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	104.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	124.6	0.0	±1.0	0.20	0.3
	2	105.0	0.0	+1.0; -5.0	0.20	0.3
	200	125.0	0.0	±1.0	0.20	0.3
SEL	2	105.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	95.8	-0.2	+1.5; -5.0	0.20	0.3

**Date of Calibration** : 19-21 Sep. 2022

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**10. Peak C sound level**

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	130.4	130.1	-0.3	3.0	0.20	0.35
Positive half cycle	129.4	129.2	-0.2	2.0	0.20	0.35
Negative half cycle	129.4	129.2	-0.2	2.0	0.20	0.35

**11. Overload indication**

Positive one-half cycle	Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Negative one-half cycle	133.5				
133.5		133.5	0.0	1.5	0.20	0.25

**12. High-level stability**

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	134.0	0.0	0.3	0.10	0.1
End	134.0				

**Calibrated by :**

**Approved by :**

(Mr. Tawikiat Iamsamran)

(Mr. Pawale Klaiyap)

**Electrical and Electronic Standards Laboratory**  
**Industrial Metrology and Testing Service Centre**

**Ref : 2011265082403762002**

**End of Certificate**

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

**Request No.** 21-65/0714

**MTC No.** EEL. BP. 76/0865

## CALIBRATION CERTIFICATE

**Submitted by** : C.E.M. TECHNOLOGY (THAILAND) CO., LTD.  
**Address** : 31/8 Moo. 13 Raikhing Samphan Nakhonparthom 73210.  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

### Instrument Calibrated :

Description : Sound Level Meter  
Manufacturer : BSWA  
Model : BSWA 309  
Serial No. : 590014 (NS-04-001)  
Microphone : MP309 No.395600  
Preamplifier : BSWA MA231T No.590612

### Ambient Environment

Temperature :  $(23 \pm 3) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 15) \%$   
Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$

### Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistomphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Date of Receipt** : 24 Aug. 2022

**Date of Calibration** : 19-21 Sep. 2022

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**Request No.** 21-65/0714

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10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

### Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

**Date of Calibration** : 19-21 Sep. 2022

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.91	113.8	113.9	0.0	1.0	0.30	N/A

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.8	0.10	N/A

#### 2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Weighting			
A-Weight	12.5	0.10	N/A
C-Weight	16.0	0.10	N/A
Flat	22.7	0.10	N/A

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	-0.1	0.0	0.0	1.5	0.45	0.6
1 000	-0.2	-0.2	-0.2	1.0	0.45	0.6
8 000	-0.3	-0.4	0.2	5.0	0.45	0.7

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	-0.1	0.0	0.0	1.5	0.20	0.6
500	-0.1	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	0.0	2.0	0.20	0.6
4 000	-0.1	0.0	0.0	3.0	0.20	0.6
8 000	-0.5	-0.5	0.0	5.0	0.20	0.7



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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0714

MTC No. EEL. BP. 76/0865

#### 5. Long-term stability

Time	Measured Value	Deviated value	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

#### 6. Frequency and time weightings at 1 kHz

##### 6.1 Frequency weightings at 1 kHz

Frequency	Measured value	Deviated value	Acceptance limit class 2 (±dB)	Uncertainty	Maximum-permitted uncertainty of measurement (±dB)
Weighting	(dB)	(dB)	(±dB)	(±dB)	(±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

##### 6.2 Time weightings at 1 kHz

Frequency	Measured value	Deviated value	Acceptance limit class 2 (±dB)	Uncertainty	Maximum-permitted uncertainty of measurement (±dB)
Weighting	(dB)	(dB)	(±dB)	(±dB)	(±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 19-21 Sep. 2022

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Request No. 21-65/0714

MTC No. EEL. BP. 76/0865

#### 7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
134	134.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3

Date of Calibration : 19-21 Sep. 2022

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
49	48.9	-0.1	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	29.1	0.1	1.1	0.30	0.3
28	28.1	0.1	1.1	0.30	0.3
27	27.1	0.1	1.1	0.30	0.3
26	26.2	0.2	1.1	0.30	0.3
25	25.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
25-137	94.0	94.0	0.0	1.1	0.30	0.3

8. Level linearity including the level range control

At reference level at 5 dB greater than the signal level that first clause an indication of under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
25-137	30.0	30.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	133.0	0.0	±1.0	0.20	0.3
	2	115.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	106.8	-0.2	+1.5; -5.0	0.20	0.3
Slow	200	126.5	-0.1	±1.0	0.20	0.3
	2	106.9	-0.1	+1.0; -5.0	0.20	0.3
	200	127.0	0.0	±1.0	0.20	0.3
SEL	2	107.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	97.8	-0.2	+1.5; -5.0	0.20	0.3





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#### 10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	132.4	132.1	-0.3	3.0	0.20	0.35
Positive half cycle	131.4	131.3	-0.1	2.0	0.20	0.35
Negative half cycle	131.4	131.3	-0.1	2.0	0.20	0.35

#### 11. Overload indication

Measured value (dB)	Deviated value (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Positive	Negative			
135.5		135.5	0.0	1.5	0.20
					0.25

#### 12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	136.0	0.0	0.3	0.10	0.1
End	136.0				

Calibrated by :

*T. H. A.*

(Mr. Tawikiat Iamsamran)

Approved by :

*Prasert Khayapa*  
(Mr. Prasert Khayapa)  
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 19-21 Sep. 2022

Date of Issue : 22 Sep. 2022

Ref : 2011265082403762001

End of Certificate

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E-mail: forthcalibration@gmail.com  
www.forthcal.com



## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0420-24

Job No. : 66S0420

Page : 1 of 2

**Customer** : C.E.M Technology (Thailand) Co., Ltd.  
**Address** : 31/8 Moo 13, Raikhing, Samphran,  
Nakhornpathom 73210  
**Location** : Laboratory

**Equipment** : Sound Level Meter  
**Manufacturer** : ACO  
**Model** : 6236  
**Serial No.** : 222193  
**Identity No.** : NS-03-023  
**Range** : See to Data

**Ambient temperature** : ( 20 ± 2 ) °C  
**Relative humidity** : ( 50 ± 15 ) %  
**Atmospheric pressure** : -  
**Date of received** : 30-Mar-2023  
**Date of calibration** : 03-Apr-2023  
**Date of issued** : 05-Apr-2023

**Calibration Method** : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

**Reference Standard Instruments** :

**Equipment** : Sound Level Calibrator  
**Model** : 8930B  
**Serial No.** : 2000210  
**Certification No.** : EEL.BP.31/0664  
**Due Date** : 15-Jun-2023

**Traceability** : This certification is traceable to the International System of Unit maintained at : -  
National Institute of Metrology Thailand, (NIMT).

**Calibrated By** : Mr. Boonyarit Auejirakarn

**Approved By** :

[ ] Ms. Bhacharin Phanangkaew (MD)

**Reviewed By** : [ ] Mr. Sompong Srisert

[ ] Mr. Boonyarit Auejirakarn

✓ [ ] Ms. Natthaprakarn Thammaphan

The reported expanded uncertainty is based uncertainty multiplied by a coverage factor k = 2, providing a level of confidence approximately 95%.  
This result relates only to the item calibrated. The certificate shall not be reproduced except in full, without the written approval of the calibration director.

Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting ( dB )	UUC Reading ( dB )	Error Value ( dB )	Uncertainty ( +/-dB )
A	94	93.8	-0.2	0.20
	104	103.8	-0.2	0.20
	114	113.8	-0.2	0.20
B	94	93.8	-0.2	0.20
	104	103.8	-0.2	0.20
	114	113.8	-0.2	0.20
Z	94	93.8	-0.2	0.20
	104	103.8	-0.2	0.20
	114	113.8	-0.2	0.20

UUC\* = Unit Under Calibration

- The End -

## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0205-5

Job No. : 66S0205

Page : 1 of 2

Customer : C.E.M Technology (Thailand) Co.,Ltd.

Address : 31/9 Moo 13, Raikhing, Samphan,

Nakhornpathom 73210

Location : Laboratory

Equipment : Sound Level Meter

Ambient temperature : ( 20 ± 2 ) °C

Manufacturer : ACO

Relative humidity : ( 50 ± 15 ) %

Model : 6236

Atmospheric pressure : -

Serial No. : 222189

Date of received : 03-Feb-2023

Identity No. : NS-03-019

Date of calibration : 07-Feb-2023

Range : See to Data

Date of issued : 09-Feb-2023

Calibration Method : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

### Reference Standard Instruments :

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

Traceability : This certification is traceable to the International System of Unit maintained at :  
- National Institute of Metrology Thailand, (NIMT).

Calibrated By : Mr. Boonyarit Auejirakarn

Approved By :

Reviewed By : [ ] Mr. Sompong Srisert

[ ] Ms. Bhacharin Phanangkaew (MD)

✓ Ms. Natthaparakarn Thammaphan

[ ] Mr. Boonyarit Auejirakarn

Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting (dB)	UUC Reading (dB)	Error Value (dB)	Uncertainty (+/-dB)
A	94	94.4	0.4	0.20
	104	104.1	0.1	0.20
	114	114.0	0.0	0.20
B	94	94.4	0.4	0.20
	104	104.1	0.1	0.20
	114	113.9	-0.1	0.20
Z	94	94.4	0.4	0.20
	104	104.1	0.1	0.20
	114	113.9	-0.1	0.20

UUC\* = Unit Under Calibration

• The End •

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

## CALIBRATION CERTIFICATE

Submitted by : C.E.M. TECHNOLOGY (THAILAND) CO., LTD.

Address : 31/8 Moo 13, Raikhing, Samphan, Nakhonpathom 73210.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

### Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 222185 (NS-03-015)

Microphone : Type 7052NR No.84149

Preamplifier : -

### Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

### Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 5 Oct. 2022

Date of Calibration : 1 Nov. 2022

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

#### Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 1 Nov. 2022

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#### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	Before adjust	After adjust				
113.97	114.1	114.0	0.0	1.0	0.30	N/A

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.5 dB.

#### 2. Self-generated noise

##### 2.1 Normal test

Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
20.9	0.10	N/A

##### 2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
A-Weight	16.4	0.10	N/A
C-Weight	21.5	0.10	N/A
Flat	26.3	0.10	N/A

Date of Calibration : 1 Nov. 2022

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight			
125	-0.2	-0.1	-0.1	0.45	0.6
1 000	0.0	0.0	0.0	0.45	0.6
8 000	-1.3	-1.4	-1.2	0.45	0.7

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight			
63	-0.3	-0.1	0.0	0.20	0.6
125	-0.4	0.1	0.0	0.20	0.6
250	-0.2	0.0	0.0	0.20	0.6
500	-0.2	0.1	0.0	0.20	0.6
1 000	0.0	0.0	0.0	0.20	0.6
2 000	0.0	0.0	0.0	0.20	0.6
4 000	-0.2	-0.3	-0.1	0.20	0.6
8 000	-0.4	-0.4	-0.2	0.20	0.7

### 5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0				
End	94.0	0.0	0.3	0.10	0.1

### 6. Frequency and time weightings at 1 kHz

#### 6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

#### 6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.8	-0.2	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.8	-0.2	1.1	0.30	0.3
49	48.8	-0.2	1.1	0.30	0.3

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
44	43.8	-0.2	1.1	0.30	0.3
39	38.8	-0.2	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.4	0.4	1.1	0.30	0.3
30	30.5	0.5	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3



### 8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	44.9	-0.1	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.5	0.5	1.1	0.30	0.3
20-100	25.0	25.4	0.4	1.1	0.30	0.3
20-90	25.0	25.5	0.5	1.1	0.30	0.3
20-80	25.0	25.5	0.5	1.1	0.30	0.3

### 9. Tone burst response

Time	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.8	-0.2	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 1 Nov. 2022

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### 10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.2	-0.2	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

### 11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle			
131.0	131.1	-0.1	1.5	0.20
				0.25

### 12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0				
End	129.0	0.0	0.3	0.10	0.1

Calibrated by : *(Signature)*

(Mr. Tawikiat Iamsamran)

Approved by : *(Signature)*

(Mr. Prateek Kluaypa)

Director

**Electrical and Electronic Standards Laboratory**  
**Industrial Metrology and Testing Service Centre**

Date of Calibration : 1 Nov. 2022

Date of Issue : 2 Nov. 2022

Ref : 2011265100504293003

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL.BP. 19/1065

## CALIBRATION CERTIFICATE

**Submitted by** : C.E.M. TECHNOLOGY (THAILAND) CO., LTD.  
**Address** : 31/8 Moo 13, Raikhing, Samphran, Nakhornpathom 73210.  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakarn 10280.

### Instrument Calibrated :

Description	Sound Level Meter	Ambient Environment Temperature	(23 ± 3) °C
Manufacturer	ACO	Relative Humidity	(50 ± 15) %
Model	6236	Ambient Pressure	(101.325 ± 1.5) kPa

Serial No. : 222129 (NS-03-014)

Microphone : Type 7052NR No.82954

Preamplifier : -

### Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 5 Oct. 2022

Date of Calibration : 1 Nov. 2022

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL.BP. 19/1065

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

### Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 1 Nov. 2022

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	Before adjust	After adjust				
113.97	113.6	114.0	0.0	1.0	0.30	N/A

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.5 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
20.1	0.10	N/A

#### 2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency	Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Weighting			
A-Weight	15.9	0.10	N/A
C-Weight	20.5	0.10	N/A
Flat	26.0	0.10	N/A

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	A-weight	C-weight			
125	0.1	0.1	1.5	0.45	0.6
1 000	-0.6	-0.6	1.0	0.45	0.6
8 000	-4.4	-4.4	5.0	0.45	0.7

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	A-weight	C-weight			
63	-0.1	0.0	2.0	0.20	0.6
125	-0.3	0.1	1.5	0.20	0.6
250	-0.1	0.1	1.5	0.20	0.6
500	-0.1	0.0	1.5	0.20	0.6
1 000	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	2.0	0.20	0.6
4 000	-0.3	-0.3	3.0	0.20	0.6
8 000	-0.5	-0.5	5.0	0.20	0.7



5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
122	122.0	0.0	1.1	0.30	0.3
121	121.0	0.0	1.1	0.30	0.3
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	108.9	-0.1	1.1	0.30	0.3
104	103.9	-0.1	1.1	0.30	0.3
99	98.9	-0.1	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.8	-0.2	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	78.9	-0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3
64	63.8	-0.2	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.8	-0.2	1.1	0.30	0.3
49	48.8	-0.2	1.1	0.30	0.3

### 7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
44	43.8	-0.2	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
33	33.3	0.3	1.1	0.30	0.3
32	32.3	0.3	1.1	0.30	0.3
31	31.6	0.6	1.1	0.30	0.3
30	30.9	0.9	1.1	0.30	0.3

### 8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 1 Nov. 2022

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### 8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	44.8	-0.2	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.5	0.5	1.1	0.30	0.3
20-100	25.0	25.4	0.4	1.1	0.30	0.3
20-90	25.0	25.5	0.5	1.1	0.30	0.3
20-80	25.0	25.6	0.6	1.1	0.30	0.3

### 9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.8	-0.2	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -5.0	0.20	0.3
	200	110.0	0.0	±1.0	0.20	0.3
SEL	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.8	-0.2	+1.5; -5.0	0.20	0.3

Date of Calibration : 1 Nov. 2022

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Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.7	0.3	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	132.1	-0.1	1.5	0.20
132.0		-0.1	1.5	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by : 

Approved by :

  
(Mr. Pannasit Phasingri)

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 1 Nov. 2022

Date of Issue : 2 Nov. 2022

Ref : 2011265100504293002

End of Certificate

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Request No. 21-66/0074

MTC No. EEL. BP. 17/1165

CALIBRATION CERTIFICATE

Submitted by : C.E.M. TECHNOLOGY (THAILAND) CO., LTD.

Address : 31/8 Moo 13, Raikhing, Samphan, Nakhonpathom 73210.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 222128 (NS-03-013)

Microphone : Type 7052NR No.84161

Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Nov. 2022

Date of Calibration : 3 Nov. 2022

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Request No. 21-66/0074

MTC No. EEL.BP. 17/1165

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

#### Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 3 Nov. 2022

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FM.BLMTC.002 Rev.4

Request No. 21-66/0074

MTC No. EEL.BP. 17/1165

#### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	Before adjust	After adjust				
113.97	113.3	114.0	0.0	1.0	0.30	N/A

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.2 dB.

#### 2. Self-generated noise

##### 2.1 Normal test

Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
20.6	0.10	N/A

##### 2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured value (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
A-Weight	16.9	0.10	N/A
C-Weight	21.7	0.10	N/A
Flat	26.0	0.10	N/A

Date of Calibration : 3 Nov. 2022

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight			
125	0.0	0.0	1.5	0.45	0.6
1 000	-0.4	-0.4	1.0	0.45	0.6
8 000	-4.3	-4.4	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)		Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight			
63	-0.4	0.0	2.0	0.20	0.6
125	-0.4	0.1	1.5	0.20	0.6
250	-0.3	0.1	1.5	0.20	0.6
500	-0.2	-0.1	1.5	0.20	0.6
1 000	0.0	-0.1	1.0	0.20	0.6
2 000	0.0	0.0	2.0	0.20	0.6
4 000	-0.2	-0.2	3.0	0.20	0.6
8 000	-0.2	-0.5	5.0	0.20	0.7

Date of Calibration : 3 Nov. 2022

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0				
End	94.0	0.0	0.3	0.10	0.1

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 3 Nov. 2022

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.3	0.3	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3
64	63.8	-0.2	1.1	0.30	0.3
59	58.8	-0.2	1.1	0.30	0.3
54	53.8	-0.2	1.1	0.30	0.3
49	48.8	-0.2	1.1	0.30	0.3

Date of Calibration : 3 Nov. 2022

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
44	43.9	-0.1	1.1	0.30	0.3
39	38.8	-0.2	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.6	0.6	1.1	0.30	0.3
20-100	25.0	25.6	0.6	1.1	0.30	0.3
20-90	25.0	25.5	0.5	1.1	0.30	0.3
20-80	25.0	25.7	0.7	1.1	0.30	0.3

9. Tone burst response

Time	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Fast	200	116.0	0.0	$\pm 1.0$	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	$\pm 1.0$	0.20	0.3
	2	89.9	-0.1	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	$\pm 1.0$	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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10. Peak C' sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Complete cycle	125.4	125.7	0.3	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
	Negative one-half cycle			
130.0	130.0	0.0	1.5	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ( $\pm$ dB)	Uncertainty ( $\pm$ dB)	Maximum-permitted uncertainty of measurement ( $\pm$ dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :  (Mr. Pannasit Phasingsri)

Approved by :  (Mr. Pannasit Phasingsri)

(Mr. Pannasit Phasingsri)

(Mr. Pannasit Phasingsri)

Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 3 Nov. 2022

Date of Issue : 3 Nov. 2022

Ref : 2011265110204749001

End of Certificate

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Certificate No.: CP20230148EA  
Operation No.: CP2023020060

### Certificate of Calibration

Equipment:	Vibration Meter
Manufacturer:	InstanTel
Model/Type:	Micromate
Serial No.:	UM16048
ID No.:	VB-01-003
Customer:	C.E.M. Technology (Thailand) Co.,Ltd.
Address:	31/8 Moo 13 T.Rai Khung, A.Sam Phran, Nakorn Phatom 73210
Received Date:	28 February 2023
Calibrated Date:	7 - 9 March 2023
Issued Date:	14 March 2023
Calibrated by:	Ms. Juntaporn Kunhakom

Approved by:  ( Mr. Sittichai Swaksuriyawong )  
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full, except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.



Certificate No.: CP20230148EA

### Calibration Report

**Equipment:** Vibration Meter  
**Manufacturer:** InstanTel  
**Model:** Micromate  
**Serial No.:** UM16048  
**ID No.:** V8-01-003  
**Ambient Temperature:** ( $23 \pm 5$  )°C  
**Relative Humidity:** ( $50 \pm 15$  )%

**Method of Calibration :-**

In-house method : CC-SV004 by comparison with standard accelerometer.

**Condition of this result of calibration**

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard Accelerometer	8305-001	30120	AV-0013-21	30-May-2023
2) Measuring Amplifier	2525	3016651	AV-0007-22	9-Jun-2023
3) PULSE Multi-analyzer system	3560-C	2705645	CO20230003EA	25-Dec-2023
4) Humidity and Temperature Transmitter	HMT331	K3810009	CD20220120EA	22-Apr-2023

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

3. This certification is traceable to the international system of unit maintained at :-

- National Institute of Metrology (Thailand)

Certificate No.: CP20230148EA

### Calibration Report

**Result of Calibration:-**

Function : Frequency response and Linearity test at 16 Hz

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty $\pm$ (%)	Direction
4.0	10.000	10.008	10.554	0.546	1.50	Longitudinal (L)
5.0	10.000	10.004	10.514	0.510	1.50	
6.3	10.000	10.007	10.633	0.626	1.50	
8.0	10.000	10.008	10.365	0.357	1.50	
10.0	10.000	10.006	10.341	0.335	1.50	
12.5	10.000	9.997	10.262	0.265	1.50	
16.0	10.000	9.998	10.262	0.264	1.50	
	20.000	19.997	20.548	0.551	1.50	
	30.000	29.995	30.786	0.791	1.50	
	50.000	49.992	51.153	1.161	1.50	
20.0	10.000	10.003	10.294	0.291	1.50	
25.0	10.000	10.000	10.341	0.341	1.50	
31.5	10.000	10.010	10.372	0.362	1.50	
40.0	10.000	9.998	10.420	0.422	1.50	
50.0	10.000	10.017	10.428	0.411	1.50	
52.0	10.000	10.001	10.522	0.521	1.50	
63.0	10.000	10.010	10.688	0.678	1.50	
80.0	10.000	10.004	10.680	0.676	1.50	





Certificate No.:

CP20230148EA

### Calibration Report

Function : Frequency response and Linearity test at 16 Hz (Cont.)

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty ± (%)	Direction
4.0	10.000	9.970	10.853	0.883	1.50	Transverse (T)
5.0	10.000	9.998	10.869	0.871	1.50	
6.3	10.000	10.000	10.901	0.901	1.50	
8.0	10.000	10.003	10.538	0.535	1.50	
10.0	10.000	10.000	10.467	0.467	1.50	
12.5	10.000	10.004	10.412	0.408	1.50	
16.0	10.000	10.001	10.428	0.427	1.50	
	20.000	19.997	20.761	0.764	1.50	
	30.000	29.995	31.031	1.036	1.50	
	50.000	49.978	51.516	1.538	1.50	
20.0	10.000	10.008	10.491	0.483	1.50	
25.0	10.000	10.000	10.475	0.475	1.50	
31.5	10.000	10.008	10.530	0.522	1.50	
40.0	10.000	10.004	10.609	0.605	1.50	
50.0	10.000	9.994	10.593	0.599	1.50	
52.0	10.000	10.001	10.688	0.687	1.50	
63.0	10.000	10.008	10.845	0.837	1.50	
80.0	10.000	10.008	10.940	0.932	1.50	

### Remark

1. UUC: Unit Under Calibration
2. The coverage factor  $k = 2.00$

-- End of Report --

Certificate No.:

CP20230148EA

### Calibration Report

Function : Frequency response and Linearity test at 16 Hz (Cont.)

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty ± (%)	Direction
4.0	10.000	10.006	10.711	0.705	1.50	Vertical (V)
5.0	10.000	10.003	10.554	0.551	1.50	
6.3	10.000	10.008	10.562	0.554	1.50	
8.0	10.000	9.991	10.128	0.137	1.50	
10.0	10.000	10.008	10.065	0.057	1.50	
12.5	10.000	10.001	10.057	0.056	1.50	
16.0	10.000	10.004	10.065	0.061	1.50	
	20.000	19.997	20.114	0.117	1.50	
	30.000	30.010	30.148	0.138	1.50	
	50.000	49.992	50.269	0.277	1.50	
20.0	10.000	9.993	10.175	0.182	1.50	
25.0	10.000	10.003	9.766	-0.237	1.50	
31.5	10.000	10.003	10.120	0.117	1.50	
40.0	10.000	10.006	10.262	0.256	1.50	
50.0	10.000	10.001	10.333	0.332	1.50	
52.0	10.000	10.000	10.374	0.374	1.50	
63.0	10.000	9.998	10.451	0.453	1.50	
80.0	10.000	10.001	10.751	0.750	1.50	

### Remark

1. UUC: Unit Under Calibration
2. The coverage factor  $k = 2.00$

-- End of Report --



ELECTRICAL AND ELECTRONICS INSTITUTE  
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37  
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Tel: +66 2709 4860 Fax: +66 2324 0917

Certificate No.: CP20230080EA  
Operation No.: CP2022100031

Certificate of Calibration

Equipment: Vibration Meter  
Manufacturer: InstanTel  
Model/Type: Micromate  
Serial No.: UM15904  
ID No.: VB-01-002  
Customer: C.E.M. Technology (Thailand) Co.,Ltd.  
Address: 31/8 Moo 13 T.Rai Khung, A.Sam Phran,  
Nakorn Phatom 73210

Received Date: 26 October 2022  
Calibrated Date: 7 - 9 February 2023  
Issued Date: 15 February 2023  
Calibrated by: Ms. Juntaporn Kunhakom

Approved by:   
( Mr. Sittichai Swaksuriyawong )  
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.



ELECTRICAL AND ELECTRONICS INSTITUTE  
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

CP20230080EA

Certificate No.: CP20230080EA

Calibration Report

Equipment: Vibration Meter  
Manufacturer: InstanTel  
Model: Micromate  
Serial No.: UM15904  
ID No.: VB-01-002  
Ambient Temperature: ( 23 ± 5 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Method of Calibration :-  
In-house method : CC-SV004 by comparison with standard accelerometer.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard Accelerometer	8305-001	30120	AV-0013-21	30-May-2023
2) Measuring Amplifier	2525	3016651	AV-0007-22	9-Jun-2023
3) PULSE Multi-analyzer system	3560-C	2705645	CO20230003EA	25-Dec-2023
4) Humidity and Temperature Transmitter	HMT331	K3810009	CD20220120EA	22-Apr-2023

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

3. This certification is traceable to the international system of unit maintained at :-

- National Institute of Metrology (Thailand)



Certificate No.: CP20230080EA

### Calibration Report

#### Result of Calibration:

Function : Frequency response and Linearity test at 16 Hz

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty $\pm$ (%)	Direction
4.0	10.000	9.997	10.514	0.517	1.50	Longitudinal (L)
5.0	10.000	10.027	10.908	0.881	1.50	
6.3	10.000	10.015	10.813	0.798	1.50	
8.0	10.000	10.027	10.489	0.462	1.50	
10.0	10.000	9.986	10.483	0.497	1.50	
12.5	10.000	10.003	10.341	0.338	1.50	
16.0	10.000	9.984	10.215	0.231	1.50	
	20.000	20.025	20.248	0.223	1.50	
	30.000	29.981	30.298	0.317	1.50	
	50.000	49.922	50.507	0.585	1.50	
20.0	10.000	9.996	10.199	0.203	1.50	
25.0	10.000	9.980	10.191	0.211	1.50	
31.5	10.000	9.974	10.183	0.209	1.50	
40.0	10.000	10.006	10.270	0.264	1.50	
50.0	10.000	10.000	10.199	0.199	1.50	
52.0	10.000	10.013	10.286	0.273	1.50	
63.0	10.000	9.976	10.325	0.349	1.50	
80.0	10.000	9.976	10.317	0.341	1.50	

Certificate No.: CP20230080EA

### Calibration Report

Function : Frequency response and Linearity test at 16 Hz (Cont.)

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty $\pm$ (%)	Direction
4.0	10.000	10.055	10.656	0.601	1.50	Transverse (T)
5.0	10.000	10.015	10.593	0.578	1.50	
6.3	10.000	9.979	10.743	0.764	1.50	
8.0	10.000	10.034	10.412	0.378	1.50	
10.0	10.000	9.969	10.341	0.372	1.50	
12.5	10.000	9.990	10.254	0.264	1.50	
16.0	10.000	9.998	10.238	0.240	1.50	
	20.000	19.983	20.304	0.321	1.50	
	30.000	29.995	30.455	0.460	1.50	
	50.000	50.007	50.633	0.626	1.50	
20.0	10.000	10.027	10.238	0.211	1.50	
25.0	10.000	9.984	10.183	0.199	1.50	
31.5	10.000	9.986	10.199	0.213	1.50	
40.0	10.000	9.994	10.215	0.221	1.50	
50.0	10.000	9.976	10.231	0.255	1.50	
52.0	10.000	9.980	10.286	0.306	1.50	
63.0	10.000	9.970	10.380	0.410	1.50	
80.0	10.000	9.994	10.467	0.473	1.50	





Certificate No.:

CP20230080EA

Calibration Report

Function : Frequency response and Linearity test at 16 Hz (Cont.)

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty ± (%)	Direction
4.0	10.000	9.966	9.718	-0.248	1.50	Vertical (V)
5.0	10.000	10.028	10.223	0.195	1.50	
6.3	10.000	9.969	10.388	0.419	1.50	
8.0	10.000	10.006	10.041	0.035	1.50	
10.0	10.000	9.993	9.971	-0.022	1.50	
12.5	10.000	9.979	9.947	-0.032	1.50	
16.0	10.000	10.004	10.049	0.045	1.50	
	20.000	19.969	20.012	0.043	1.50	
	30.000	29.981	29.888	-0.093	1.50	
	50.000	49.978	49.868	-0.110	1.50	
20.0	10.000	10.015	10.152	0.137	1.50	
25.0	10.000	9.977	9.655	-0.322	1.50	
31.5	10.000	10.014	10.081	0.067	1.50	
40.0	10.000	10.020	10.238	0.218	1.50	
50.0	10.000	10.031	10.380	0.349	1.50	
52.0	10.000	9.982	10.294	0.312	1.50	
63.0	10.000	9.987	10.428	0.441	1.50	
80.0	10.000	9.994	10.751	0.757	1.50	

Remark

1. UUC: Unit Under Calibration
2. The coverage factor  $k = 2.00$

-- End of Report --

Calibration Certificate

Part Number: 721A2601  
Description: Micromate with DIN Geophone  
Serial Number: UM20453  
Calibration Date: April 21, 2023  
Calibration Reference Equipment: SRV-AFR 71417401  
\*Calibrated with Geo UM6231

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

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

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

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

Calibrated By:   
Yaksh Patel  
Instantel  
309 Leggett Drive, Ottawa, Ontario K2K 3A3, (613) 592-4642

Frequency Response of UM20453 (As Found)

