

ภาคผนวกที่ 4

สรุปเอกสารสอบเทียบอุปกรณ์เครื่องมือ

เอกสารการสอบเทียบเครื่องมือตรวจวัดคุณภาพน้ำ

		CERTIFICATE OF CONFORMITY	
Aquion System			
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	Aquion Final Test	
<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	Area	Average	%RSD	Retention Time
Injector Precision: 50 ppm	2.576 µS*min	0.106%	≤ 1%	Average
			Pass	0.373 min
				Max-Min
				0.0100 min
				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

China RoHS
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 Ratchadriwet 24, Pracharabamphen,
Samsaenok, HuaiKhwang, 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


 Service Engineer : _____
 (Teerapon Tawonwong)
 December 21, 2022

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
Environmental	Temperature 25.0 °C Relative Humidity 45.7 °C Gases - Carrier Gas : Helium = 1ml/min - Hydrogen = 35 ml/min - Air = 350 ml/min - Make-up Gas: Nitrogen = 30ml/min Oven - Initial Temperature = 50°C - Initial Time = 1 minute - Ramp 1 = 20 °C/minute - Final Temperature = 200°C - Final Time = 1 minute
Instrument Condition	Injector - Operating Mode = Split - Temperature = 230 °C - Split Flow 40. ml/min - Purge Flow rate = 5 ml/min Detector - Base Temperature = 250 °C - Detector Signal Range = 10° Injected Volume - 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): 2018000012164 (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.

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

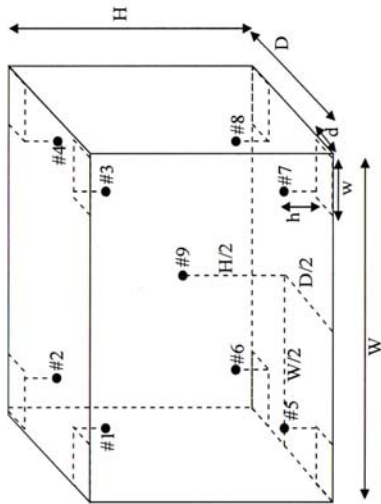
Delivering Growth - in Asia and Beyond.

CAL-FM-C31-10: 12 Sep 2022



Certificate No.: C31230380

Page: 2 of 3



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.

DKSH Technology Limited
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



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.

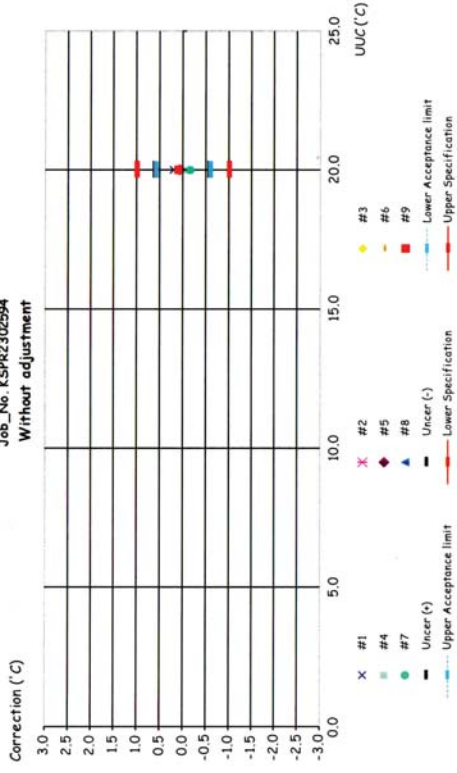
The End of Statements of Conformity



Corr_Distribution & Max_Measurement Uncertainty

Job_No. KSPR2302594

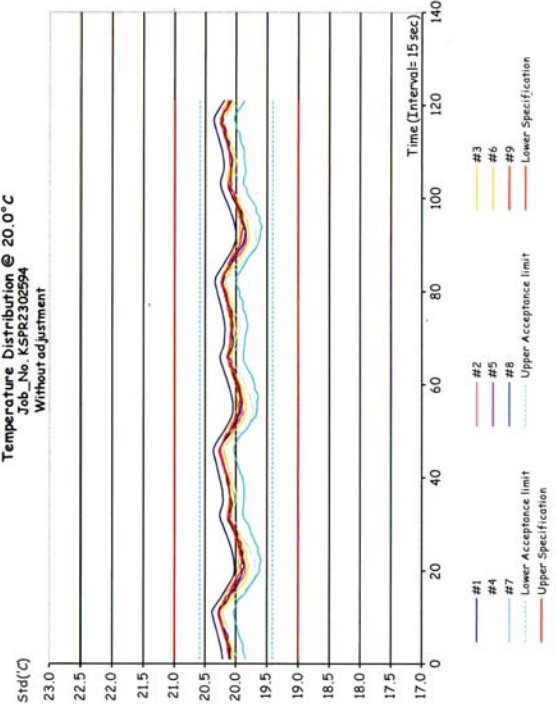
Without adjustment



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)	รายการตรวจเช็ค		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. สภาพ Lever of Ventilation valve	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพ Lever door open / close	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาพ 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"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. สภาพตัวเครื่อง	<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"/>	

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

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.

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

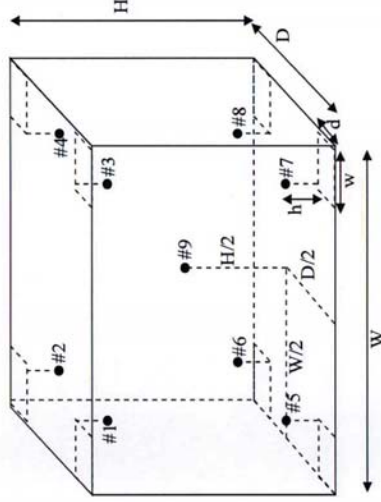
Delivering Growth - in Asia and Beyond.

CAL-FM-C31-10: 12 Sep 2022



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.

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.

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok 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

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.

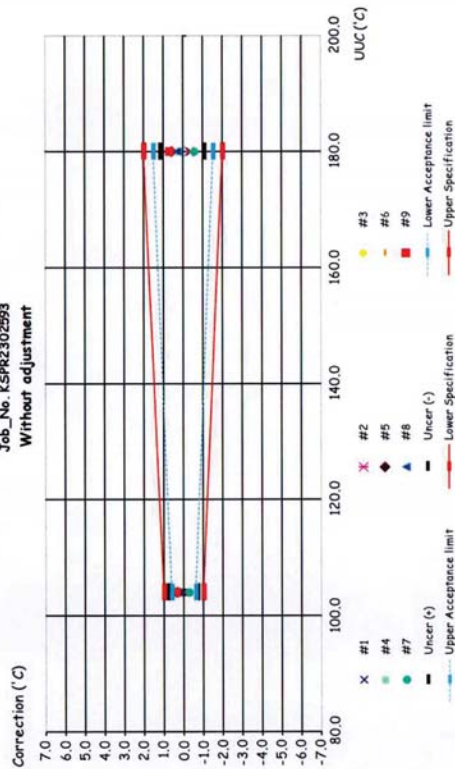
The End of Statements of Conformity

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

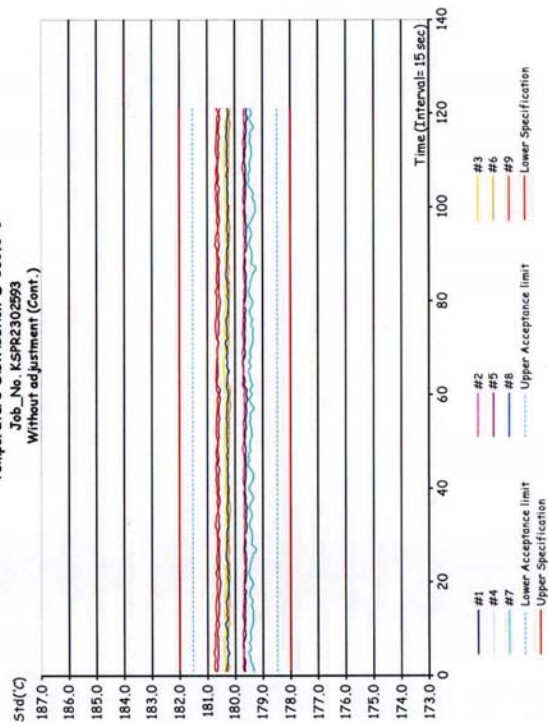
Delivering Growth - in Asia and Beyond.

CAL-FM-C31-10: 12 Sep 2022

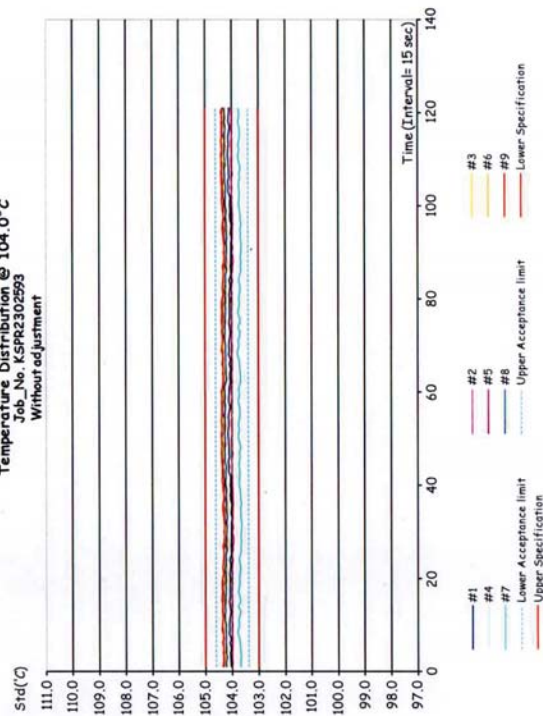
Corr_Distribution & Max_Measurement Uncertainty
Job_No. KSPR2302593
Without adjustment



Temperature Distribution @ 180.0°C
Job_No. KSPR2302593
Without adjustment (Cont.)



Temperature Distribution @ 104.0°C
Job_No. KSPR2302593
Without adjustment





ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2302593

รุ่น: UF 55

ชนิดเครื่อง: Hot Air Oven

หมายเลขเครื่อง: B219.0142 (WW-05-002)

ตรวจสอบ (รับ)		รายการตรวจสอบ	ตรวจสอบ (ส่ง)		หมายเหตุ
15 Feb 2023			15 Feb 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	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 checked="" type="checkbox"/>	<input type="checkbox"/>	6. สวิท Lever of Ventilation valve	<input checked="" 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 type="checkbox"/>	<input type="checkbox"/>	10. การทำงานของระบบทำความเย็น	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input type="checkbox"/>	<input type="checkbox"/>	11. การทำงานของระบบทำความร้อน	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input 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 ตำบลบางนาเหนือ เขตภาษีเจริญ กรุงเทพมหานคร 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/identify-thailand

Delivering Growth - in Asia and Beyond.

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%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



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%
This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



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-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



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

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



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

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.
4/176 Soi Ladplakao 66, Ladplakao Rd., Anusawari, Bangkok, Bangkok 10220
Tel: (662) 971-5800
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



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



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 -



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.
The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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

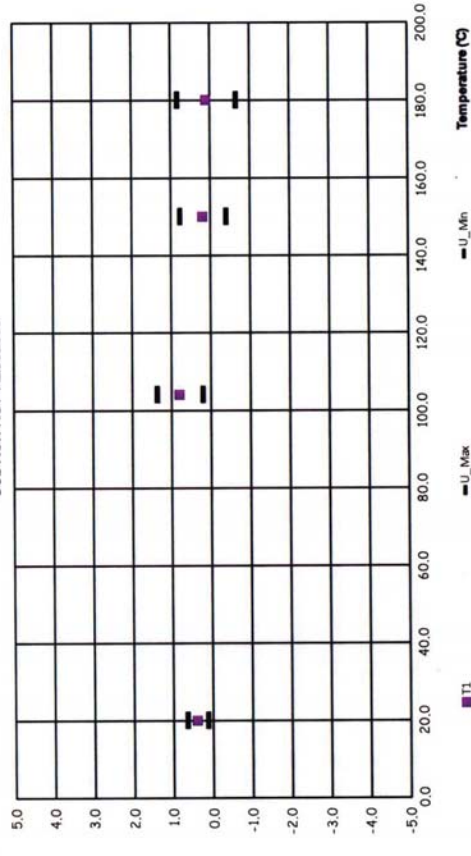
DKSH Technology (Thailand) Co., Ltd.
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C15-14: 06 Dec 2022



Without Adjustment
Job No.: KSPR2302595



ใบตรวจสอบสภาพเครื่องมือวัดอุณหภูมิ

เลขที่ใบงาน: KSPR2302595
รุ่น: TK 61

ชนิดเครื่องมือ: Digital Thermometer with Sensor
หมายเลขเครื่อง: IP181269184

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

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2638 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - in Asia and Beyond.



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
Manufacturer Merck
Serial No. 19490640
Description Resolution of UUC : 1 °C

Model TR420
ID No. WW-07-002

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

Calibration Location Laboratory
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)

This calibration certificate shall not be reproduced other than in full except with the prior written approval of the Thai Heart Calibration Co., Ltd.

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

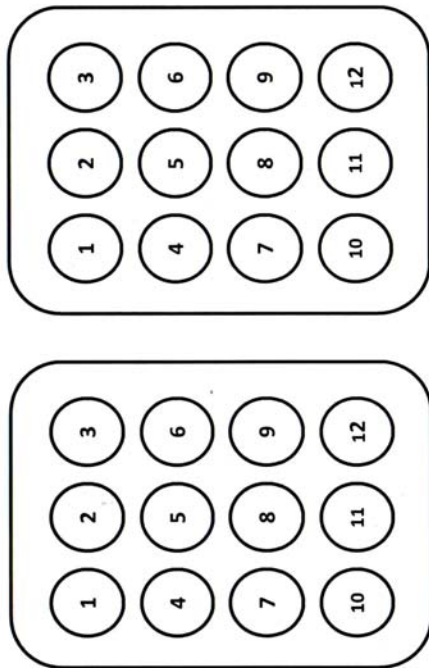
FE-169

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%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



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



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/m³)**

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

This calibration certificate may not be reproduced other than in full,
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.

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



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

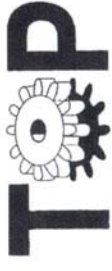
The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor (k), which for a normal distribution corresponds to a coverage probability of approximately 95% (confidence level).

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: 17 Oct 22
Sampler: TE-5000 TSP Serial No: 3271 Tech: Tong.P

Site Conditions

Barometric Pressure (in Hg): 28.60 Corrected Pressure (mm Hg): 758.6
Temperature (deg F): 75.7 Temperature (deg K): 297.4
Average Press. (in Hg): 28.40 Corrected Average (mm Hg): 760.1
Average Temp (Deg F): 76.2 Average Temp: (Deg K): 297.7

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	7.70	1.763	55.0	55.00	Slope: 28.9848
2	5.90	1.544	49.0	49.00	Intercept: 4.1522
3	4.80	1.394	45.0	45.00	Corr. Coeff: 0.9993
4	3.60	1.208	39.0	39.00	
5	3.00	1.104	36.0	36.00	# 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): 40.6

Average Flow Calculation m3/min
1.258264079

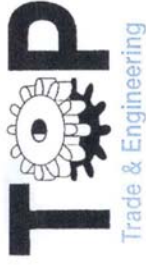
Average Flow Calculation in cfm
44.4302282

Sample Time (Hrs): 24.0
Total flow in 24 hours m3/min
1811.900274

Total flow in 24 hours cfm
63979.5286

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

เอกสารการสอบเทียบเครื่องมือตรวจวัดคุณภาพอากาศในบรรยากาศ



TSP High Volume Sampler TE-5000 TSP Sampler Verification

Site Information

Location: - Date: 9 Jan 23
Sampler: TE-5000 TSP Serial No: 3268 Tech: Tong.P

Site Conditions

Barometric Pressure (in Hg): 27.60 Corrected Pressure (mm Hg): 701.0
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): 75.2 Average Temp: (Deg K): 297.2

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 (chart)	IC (corrected)	Linear Regression
1	7.30	1.650	62.7	60.26	Slope: 35.0463
2	5.50	1.433	56.0	53.82	Intercept: 2.9864
3	4.10	1.239	48.8	46.90	Corr. Coeff: 0.9975
4	3.60	1.162	45.6	43.83	
5	3.00	1.061	41.1	39.50	# 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:
 $1/m[(I[\text{Sqrt}(298/Tav)(Pav/760)]-b)]$

Enter Average I (chart): 49.0
Average Flow Calculation m3/min
1.244829703
Average Flow Calculation in cfm
43.95585051
Sample Time (Hrs): 24.0
Total flow in 24 hours m3/min
1792.554772
Total flow in 24 hours cfm
63296.42474

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

Tisch Environmental 145 South Miami Ave, Cleves OH 45002 • 877.263.7610 • sales@tisch-env.com • www.tisch-env.com



TSP High Volume Sampler TE-5000 TSP Sampler Verification

Site Information

Location: - Date: 17 Oct 22
Sampler: TE-5000 TSP Serial No: 3269 Tech: Tong.P

Site Conditions

Barometric Pressure (in Hg): 29.20 Corrected Pressure (mm Hg): 760.6
Temperature (deg F): 77.1 Temperature (deg K): 298.2
Average Press. (in Hg): 29.80 Corrected Average (mm Hg): 760.5
Average Temp (Deg F): 77.9 Average Temp: (Deg K): 298.7

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)	IC (corrected)	Linear Regression
1	7.60	1.751	53.0	53.00	Slope: 28.3923
2	5.70	1.518	48.0	48.00	Intercept: 4.0489
3	4.50	1.350	43.0	43.00	Corr. Coeff: 0.9959
4	3.40	1.174	37.0	37.00	
5	2.80	1.067	34.0	34.00	# 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:
 $1/m[(I[\text{Sqrt}(298/Tav)(Pav/760)]-b)]$

Enter Average I (chart): 38.0
Average Flow Calculation m3/min
1.194766279
Average Flow Calculation in cfm
42.18807427
Sample Time (Hrs): 24.0
Total flow in 24 hours m3/min
1720.463442
Total flow in 24 hours cfm
60750.82695

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

Tisch Environmental 145 South Miami Ave, Cleves OH 45002 • 877.263.7610 • sales@tisch-env.com • www.tisch-env.com



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:

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

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

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: 3263 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): 26.00 Corrected Average (mm Hg): 660.4
Average Temp (Deg F): 75.1 Average Temp: (Deg K): 297.1

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	5.80	1.482	60.0	58.08	Slope: 28.6275
2	4.00	1.233	53.0	51.31	Intercept: 15.8460
3	2.60	0.996	46.0	44.53	Corr. Coeff: 0.9996
4	2.10	0.896	43.0	41.62	
5	1.50	0.759	38.5	37.27	# 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:

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

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

inter Average I (chart): 44.0
Average Flow Calculation m3/min
0.881394911
Average Flow Calculation in cfm
31.12270125
Sample Time (Hrs): 24.0
Total flow in 24 hours m3/min
1269.208672
Total flow in 24 hours cfm
44816.6898

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



TSP High Volume Sampler TE-5000 TSP Sampler Verification

Site Information

Location: - Site ID: - Date: 9 Jan 23
Sampler: TE-5000 TSP Serial No: 3262 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): 27.00 Corrected Average (mm Hg): 685.8
Average Temp (deg F): 75.8 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	8.20	1.792	62.0	61.08	Slope: 37.2576
2	6.40	1.584	55.0	54.18	Intercept: -5.2773
3	5.00	1.401	48.0	47.29	Corr. Coeff: 0.9987
4	4.50	1.330	45.0	44.33	
5	3.90	1.239	41.0	40.39	
					# of Observations: 5

Calculations

$Q_{std} = 1/m[\sqrt{(H_2O)(P_{std})(T_{std}/T_a)} - b]$
 $IC = I[\sqrt{(P_a/P_{std})(T_{std}/T_a)}]$
 Q_{std} = standard flow rate
 IC = corrected chart response
 I = actual chart response
 m = calibrator Qstd slope
 b = calibrator Qstd intercept
 T_a = actual temperature during calibration (deg K)
 P_a = actual pressure during calibration (mm Hg)
 T_{std} = 298 deg K
 P_{std} = 760 mm Hg
For subsequent calculation of sampler flow:
 $1/m[(I) \sqrt{(P_a/P_{std})(T_{std}/T_a)} - b]$
 m = sampler slope
 b = sampler intercept
 I = chart response
 Tav = daily average temperature
 Pav = daily average pressure

inter Average I (chart): 44.0
Average Flow Calculation m3/min 1.264452021
Average Flow Calculation in cfm 44.64872898
Sample Time (Hrs): 24.0
Total flow in 24 hours m3/min 1820.810911
Total flow in 24 hours cfm 64294.16973

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: 3524 Tech: Tong P.

Site Conditions

Barometric Pressure (in Hg): 27.45 Corrected Pressure (mm Hg): 760.1
Temperature (deg F): 77.5 Temperature (deg K): 298.3
Average Press. (in Hg): 29.20 Corrected Average (mm Hg): 760.0
Average Temp. (deg F): 77.6 Average Temp. (deg K): 298.3

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
1	7.90	1.122	59.0	36.96	Slope 30.7009
2	6.10	0.987	54.0	33.83	Intercept 3.0086
3	4.90	0.886	49.0	30.70	Corr. Coeff 0.9957
4	4.10	0.811	44.0	27.56	SFR 1.130
5	2.90	0.683	38.0	23.80	SSP 60.17
					# of Observations: 5

Calculations

$Q_a = 1/m[\sqrt{(H_2O)(T_a/P_a)} - b]$
 $IC = I[\sqrt{(P_a/P_{std})(T_{std}/T_a)}]$
 m = sampler slope
 b = sampler intercept
 I = chart response
 Tav = daily average temperature
 Pav = daily average pressure

 Q_a = actual flow rate
 IC = corrected chart response
 m = calibrator slope
 b = calibrator intercept
 T_a = actual temperature (deg K)
 P_a = actual pressure (mm Hg)
For subsequent calculation of sampler flow:
 $1/m[(I) \sqrt{(P_a/P_{std})(T_{std}/T_a)} - b]$
 $SFR = 1.13(P_s/P_a)(T_a/T_s)$
 $SSP = (m \cdot SFR + b) / (\sqrt{(P_a/T_a)})$
 SFR = sampler set point flow rate
 SSP = sampler chart set point
 m = sampler slope
 T_a = actual temperature (deg K)
 P_a = actual pressure (mm Hg)
 T_s = Average temperature (deg K)
 P_s = Average pressure (mm Hg)

Average I (chart): 55.7
Average Flow over Sample (m3/min) 1.038708375
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min) 1495.740061
Total flow over sample (CFM) 52814.58154

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: 3211 Tech: Tong P.

Site Conditions

Barometric Pressure (in Hg): 26.54 Corrected Pressure (mm Hg): 760.4
Temperature (deg F): 77.9 Temperature (deg K): 298.5
Average Press. (in Hg): 29.45 Corrected Average (mm Hg): 759.8
Average Temp. (deg F): 77.0 Average Temp. (deg K): 298.0

Calibration Office

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
1	7.30	1.079	55.0	34.46	Slope 30.9235
2	5.50	0.938	50.0	31.33	Intercept
3	4.30	0.830	44.0	27.57	Corr. Coeff 0.9941
4	3.70	0.771	41.0	25.69	SFR 1.131
5	2.80	0.672	35.0	21.93	SSP 58.48

of Observations: 5

Calculations

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

$$SFR = 1.13(Ps/Pa)(Ta/Ts)$$

$$SSP = (m \cdot SFR + b)(\sqrt{(Pa/Ta)})$$

SFR = sampler set point flow rate

SSP = sampler chart set point

m = sampler slope

b = sampler intercept

Ta = actual temperature (deg K)

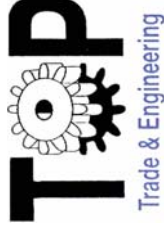
Pa = actual pressure (mm Hg)

Ts = Average temperature (deg K)

Ps = Average pressure (mm Hg)

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

Average I (chart): 55.1
Average Flow over Sample (m3/min): 1.062113613
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min): 1529.443603
Total flow over sample (CFM): 54004.65361



PM10 High Volume Sampler Verification

Site Information

Location: - Site ID: - Date: 2 October 2023
Sampler: TE-6070 PM10 Serial No: 3183 Tech: Tong P.

Site Conditions

Barometric Pressure (in Hg): 27.02 Corrected Pressure (mm Hg): 686.3
Temperature (deg F): 75.3 Temperature (deg K): 297.1
Average Press. (in Hg): 26.70 Corrected Average (mm Hg): 678.2
Average Temp. (deg F): 76.1 Average Temp. (deg K): 297.5

Calibration Office

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
1	9.45	1.287	60.5	39.80	Slope 36.1461
2	7.75	1.167	55.3	36.38	Intercept
3	6.50	1.069	50.7	33.36	Corr. Coeff 0.9935
4	5.75	1.006	45.3	29.80	SFR 1.115
5	4.60	0.901	39.6	26.05	SSP 51.87

of Observations: 5

Calculations

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

$$SFR = 1.13(Ps/Pa)(Ta/Ts)$$

$$SSP = (m \cdot SFR + b)(\sqrt{(Pa/Ta)})$$

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 office has been certified within 12 months of use

Average I (chart): 50.3
Average Flow over Sample (m3/min): 1.092521097
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min): 1573.23038
Total flow over sample (CFM): 55550.76473



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.
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) (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 = calibrator slope
b = calibrator 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 use



PM10 High Volume Sampler Verification

Site Information

Location: - Site ID: - Date: 10 January 2023
Sampler: TE-6070 PM10 Serial No: 1629 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): 297.4
Average Press. (in Hg): 28.50 Corrected Average (mm Hg): 723.9
Average Temp. (deg F): 75.6 Average Temp. (deg K): 297.2

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) (corrected)	IC	Linear Regression	# of Observations:
1	8.10	1.152	59.2	37.62	Slope 31.6154	5
2	6.30	1.017	54.2	34.44	Intercept 1.7368	
3	5.10	0.916	49.2	31.26	Corr. Coeff 0.9952	
4	4.30	0.842	44.1	28.02	SFR 1.111	
5	3.10	0.716	38.0	24.15	SSP 58.03	

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 = calibrator slope
b = calibrator intercept
Ta = actual temperature (deg K)
Pa = actual pressure (mm Hg)
Ts = Average temperature (deg K)
Ps = Average pressure (mm Hg)

Average I (chart): 56.9
Average Flow over Sample (m3/min) 1.098289496
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min) 1581.536874
Total flow over sample (CFM) 55844.06701

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



Certificate of Analyzer Performance Testing

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

Analyzer Instruments : CO Analyzer
Model : 48C
Environmental Temperature : 26.4 °C
Humidity : 52.7 %RH
Manufacturer : Thermo Environmental
Serial No. : 71021-387

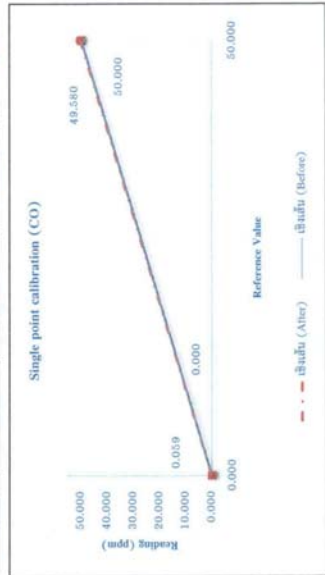
Calibrator System : Thermo Environmental
Units : API
Model : 146C
Serial No. : 514611458
Standard Gas : Zero Air Generator
NO Conc. : 2 ppm
SO2 Conc. : 2 ppm
CO Conc. : 50 ppm

Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
CO	0.039	0.000	0.06	49.580	50.000	-0.84
	0.000	0.000	0.00	50.000	50.000	0.00

Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
CO	0.039	0.000	0.06	49.580	50.000	-0.84
	0.000	0.000	0.00	50.000	50.000	0.00



Calibrated by :
(Mr. Tong Pina)



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

Calibration Office

Make : Tisch Environmental, Inc.
Model : TE-5028A
Serial# : 1179
Qstd Slope : 1.58304
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	8.80	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

$Qa = 1/m(\sqrt{(H_2O)(Ta/Pa)}) - b$
 $IC = I(\sqrt{(Ta/Pa)})$
 $SFR = 1.13(Ps/Pa)(Ta/Ts)$
 $SSP = (m \cdot SFR + b) / (\sqrt{(Ta/Pa)})$
 $m = \text{sampler slope}$
 $b = \text{sampler intercept}$
 $I = \text{chart response}$
 $Tav = \text{daily average temperature}$
 $Pav = \text{daily average pressure}$
 $SFR = \text{sampler set point flow rate}$
 $SSP = \text{sampler chart set point}$
 $m = \text{sampler slope}$
 $b = \text{sampler intercept}$
 $Ta = \text{actual temperature (deg K)}$
 $Pa = \text{actual pressure (mm Hg)}$
 $Ts = \text{Average temperature (deg K)}$
 $Ps = \text{Average pressure (mm Hg)}$
 $\text{Average } I(\text{chart}) : 34.5$
 $\text{Average Flow over Sample (m3/min)} : 0.727985358$
 $\text{Enter Total Time (Hrs)} : 24.0$
 $\text{Total flow over sample (m3/min)} : 1048.298915$
 $\text{Total flow over sample (CFM)} : 37015.43469$

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

Certificate of Analyzer Performance Testing

Calibrated Date : 10-Jun-23 Certificate No. : 0823-001 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

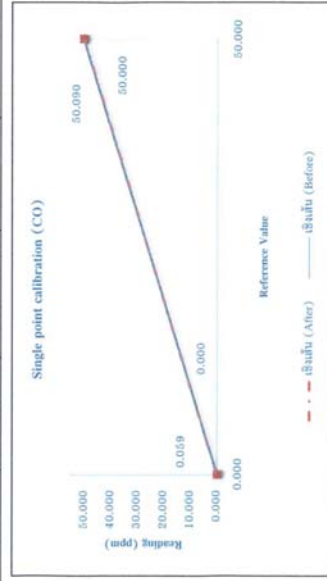
Calibration System

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	0.059	0.000	0.06	50.1	50.000	0.18
	Before					
CO	0.000	0.000	0.00	50.0	50.000	0.00
	After					



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

Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23 Certificate No. : 0823-006 Page : 1/1

Analyzer Instruments
 Analyzer Type : CO Analyzer
 Model : 48C
 Manufacturer : Thermo Environmental
 Serial No. : 508011064

Environmental
 Temperature : 24.9 °C
 Humidity : 41.3 %RH

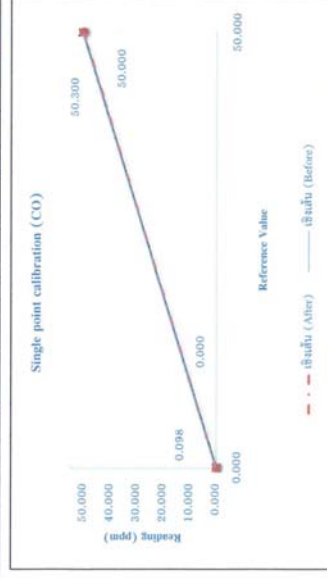
Calibration System

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 (%)
CO	0.098	0.000	0.10	50.3	50.000	0.60
	Before					
CO	0.000	0.000	0.00	50.0	50.000	0.00
	After					



Calibrated by : *Top*
 (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 Manufacturer : Thermo Environmental
 Model : 48C Serial No. : 508011069

Environmental
 Temperature : 25.5 °C
 Humidity : 53.7 %RH

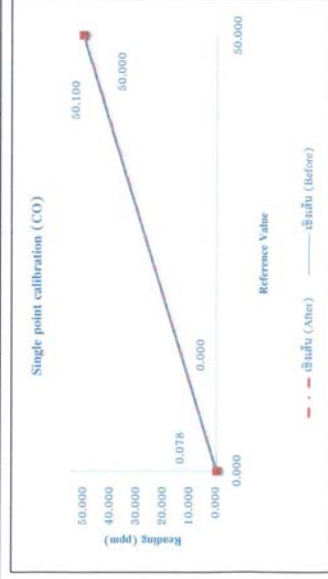
Calibration System

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

Standard Gas
 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 (%)
CO	Before					
	0.076	0.060	0.08	50.1	50.000	0.20
CO	After					
	0.000	0.000	0.00	50.0	50.000	0.00



Calibrated by :  (Mr. Yong Prima)

Certificate of Analyzer Performance Testing

Calibrated Date : 6-Apr-22 Certificate No. : 0422-054 Page : 1/1

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

Environmental
 Temperature : 24.1 °C
 Humidity : 49.3 %RH

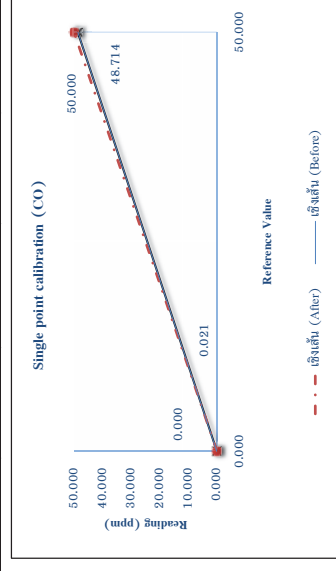
Calibration System


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

Standard Gas
 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 (%)
CO	Before					
	0.021	0.000	0.02	48.714	50.000	-2.57
CO	After					
	0.000	0.000	0.00	50.000	50.000	0.00



Calibrated by :  (Mr. Yong Prima)

Certificate of Analyzer Performance Testing

Calibrated Date : 11-Mar-23 Certificate No. : 0323-001 Page : 1/1

Analyzer Instruments

Analyzer Type : CO Analyzer Manufacturer : Thermo Environmental
Model : 48C Serial No. : 65775350

Environmental

Temperature : 24.3 °C
Humidity : 51.4 %RH

Calibration System

Calibrator Units

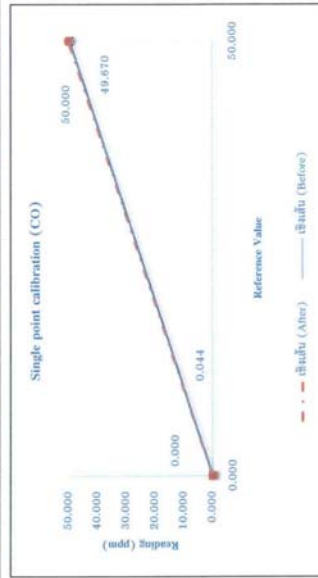
Gas Calibration : Thermo Environmental : API
Model : 146C Model : 701
Serial No. : 514811458 Serial No. : 179

Standard Gas

NO Conc. : 2 ppm
SO2 Conc. : 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 (%)	
CO	Before							
	0.044	0.000	0.04		49.670	50.000	-0.66	
CO	After							
	0.000	0.000	0.00		50.000	50.000	0.00	



Calibrated by :

Tanji
(Mr. Yong Pima)

Certificate of Analyzer Performance Testing

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

Analyzer Instruments

Analyzer Type : SO2 Analyzer Manufacturer : Thermo Environmental
Model : 43C Serial No. : 69858-364

Environmental

Temperature : 25.2 °C
Humidity : 52.3 %RH

Calibration System

Calibrator Units

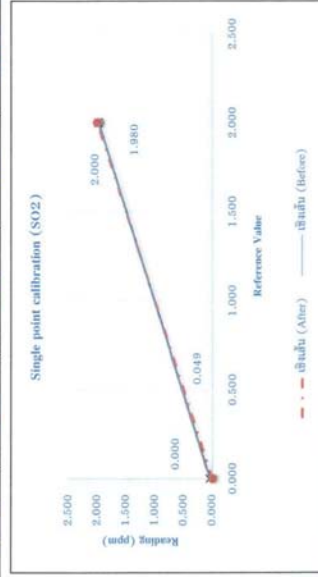
Gas Calibration : Thermo Environmental : API
Model : 146C Model : 701
Serial No. : 514811458 Serial No. : 179

Standard Gas

NO Conc. : 2 ppm
SO2 Conc. : 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 (%)	
SO2	Before							
	0.049	0.000	0.05		1.98	2.000	-1.00	
SO2	After							
	0.000	0.000	0.00		2.00	2.000	0.00	



Calibrated by :

Tanji
(Mr. Yong Pima)

Certificate of Analyzer Performance Testing

Calibrated Date : 1-Sep-22 Certificate No. : 0925-001 Page : 1/1

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

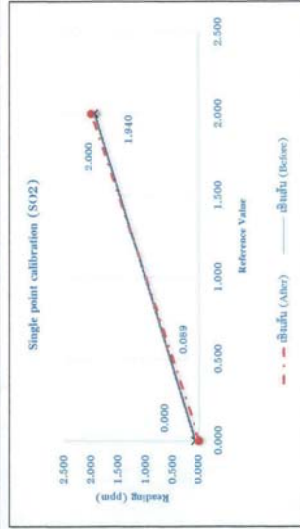
Environmental
 Temperature : 25.2 °C
 Humidity : 52.0 %RH

Calibration 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. : C750227
 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 (%)
Before						
SO2	0.089	0.000	0.00	1.94	2.000	-3.00
After						
SO2	0.000	0.000	0.00	2.00	2.000	0.00



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

Certificate of Analyzer Performance Testing

Calibrated Date : 3-Oct-22 Certificate No. : 1025-001 Page : 1/1

Analyzer Instruments
 Analyzer Type : SO2 Analyzer Manufacturer : Thermo Environmental
 Model : 43C Serial No. : C71163568-340

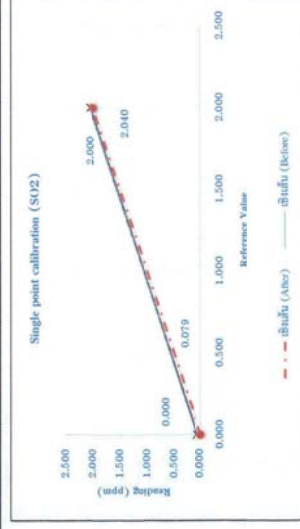
Environmental
 Temperature : 24.1 °C
 Humidity : 52.1 %RH

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

Standard Gas
 NO Conc. : 2 ppm Cylinder No. : C750227
 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 (%)
Before						
SO2	0.079	0.000	0.08	2.04	2.000	2.00
After						
SO2	0.000	0.000	0.00	2.00	2.000	0.00



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

Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23 Certificate No. : 0821-004
Page : 1/1

Analyzer Instruments

Analyzer Type : SO2 Analyzer Manufacturer : Thermo Environmental
Model : 43C Serial No. : 43C-77419-385

Environmental
Temperature : 25.1 °C
Humidity : 46.2 %RH

Calibration System

Calibrator Units

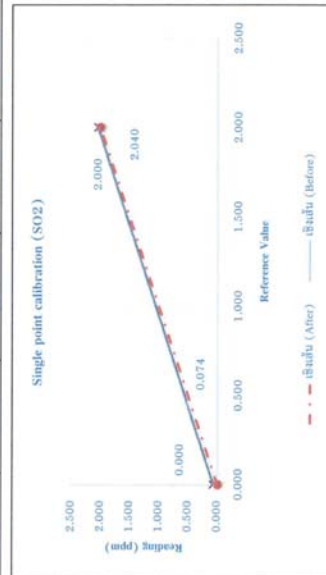
Gas Calibration : Thermo Environmental Zero Air Generator : API
Model : 146C Model : 701
Serial No. : 514811458 Serial No. : 179

Standard Gas

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					
	0.074	0.000	0.07	2.04	2.000	2.00
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 : 30-Aug-22 Certificate No. : 0822-005
Page : 1/1

Analyzer Instruments

Analyzer Type : SO2 Analyzer Manufacturer : Thermo Environmental
Model : 43C Serial No. : 708453-367

Environmental
Temperature : 25.7 °C
Humidity : 54.1 %RH

Calibration System

Calibrator Units

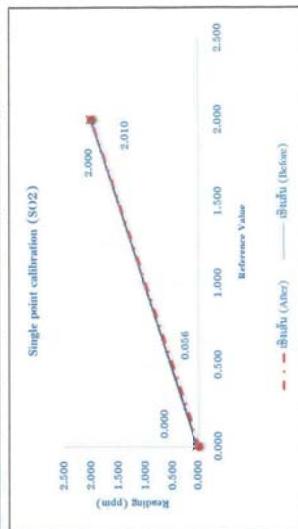
Gas Calibration : Thermo Environmental Zero Air Generator : API
Model : 146C Model : 701
Serial No. : 514811458 Serial No. : 179

Standard Gas

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					
	0.056	0.000	0.06	2.01	2.000	0.50
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 : 9-Aug-22 Certificate No. : 0822-002 Page : 1/1

Analyzer Instruments
 Analyzer Type : NO/NO_x Analyzer
 Model : 49C
 Manufacturer : Thermo Environmental
 Serial No. : 50601107

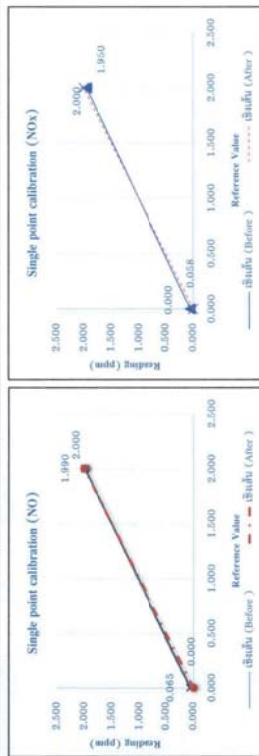
Environmental
 Temperature : 25.2 °C
 Humidity : 54.9 %RH

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

Calibration Check

Gas	Zero		Drift (%)	Span		Drift (%)
	Reading Value (ppm)	Expected Value (ppm)		Reading Value (ppm)	Expected Value (ppm)	
NO	0.065	0.000	0.07	1.99	2.00	-0.50
	0.058	0.000	0.06	1.95	2.00	-2.50
NO _x	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 :
 (Mr. Tong Pima)

Certificate of Analyzer Performance Testing

Calibrated Date : 1-Sep-22 Certificate No. : 0922-003 Page : 1/1

Analyzer Instruments
 Analyzer Type : NO/NO_x Analyzer
 Model : 49C
 Manufacturer : Thermo Environmental
 Serial No. : 461931-353

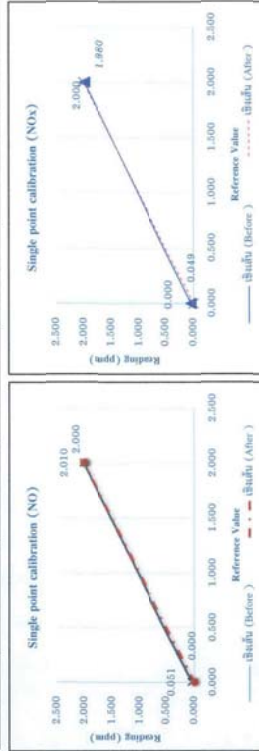
Environmental
 Temperature : 26.7 °C
 Humidity : 56.9 %RH

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

Calibration Check

Gas	Zero		Drift (%)	Span		Drift (%)
	Reading Value (ppm)	Expected Value (ppm)		Reading Value (ppm)	Expected Value (ppm)	
NO	0.051	0.000	0.05	2.01	2.00	0.50
	0.049	0.000	0.05	1.98	2.00	-1.00
NO _x	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 :
 (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/NOx/NOx Analyzer Manufacturer : Thermo Environmental
Model : 42C Serial No. : 59406-323

Environmental

Temperature : 26.3 °C
Humidity : 42.5 %RH

Calibration System

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

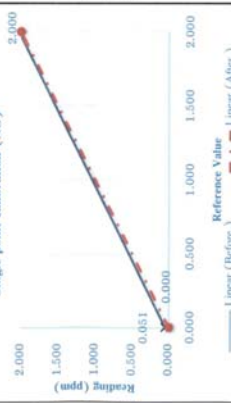
Standard Gas

NO Conc. : 2 ppm : CC750227
SO2 : 2 ppm : 21-Nov-23
CO Conc. : 50 ppm

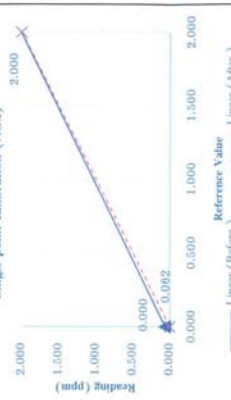
Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
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

Single point calibration (NO)



Single point calibration (NOx)



Calibrated by :

Top
(Mr. Tong Pima)

Certificate of Analyzer Performance Testing

Calibrated Date : 1-Apr-23 Certificate No. : 0423-004 Page : 1/1

Analyzer Instruments

Analyzer Type : NO/NOx/NOx Analyzer Manufacturer : Thermo Environmental
Model : 42C Serial No. : 72454-371

Environmental

Temperature : 25.2 °C
Humidity : 52.3 %RH

Calibration System

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

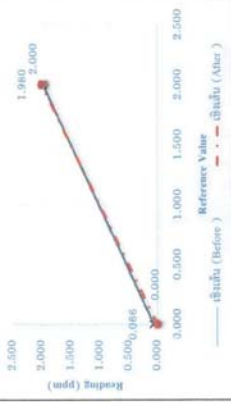
Standard Gas

NO Conc. : 2 ppm : CC750227
SO2 : 2 ppm : 21-Nov-23
CO Conc. : 50 ppm

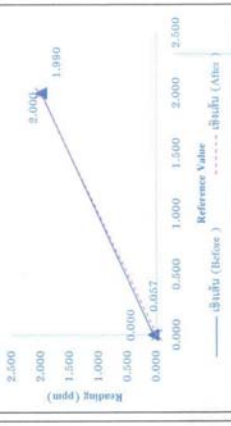
Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
NO	0.046	0.000	0.07	1.98	2.00	-1.00
	0.057	0.000	0.08	1.99	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

Single point calibration (NO)



Single point calibration (NOx)



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_x/NO_x Analyzer
 Model : 42C
 Manufacturer : Thermo Environmental
 Serial No. : 58926-320

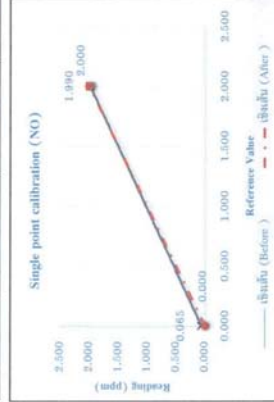
Environmental
 Temperature : 24.3 °C
 Humidity : 51.4 %RH

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

Standard Gas
 NO Conc. : 2 ppm
 SO₂ : 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 (%)
NO	0.065	0.000	0.07	1.99	2.00	-0.50
	0.052	0.000	0.05	1.97	2.00	-1.50
NO _x	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 : *Taylor*
(Mr. Teeg Pima)

Certificate of Analyzer Performance Testing

Calibrated Date : 30-Jan-23 Certificate No. : 0125-002 Page : 1/1

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

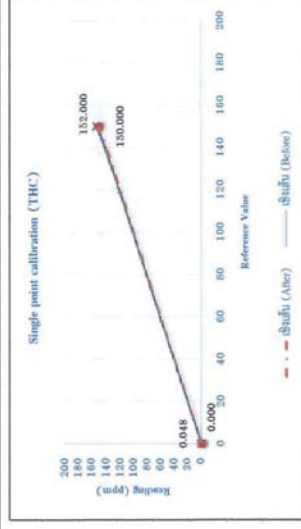
Environmental
 Temperature : 24.5 °C
 Humidity : 56.3 %RH

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

Standard Gas
 Prepane 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
	0.000	0.000	0.000	150	150	0.000



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

Certificate of Analyzer Performance Testing

Certificate No. : 0123-001
Page : 1/1

Calibrated Date : 30-Jan-23
Analyzer Instruments : THC Analyzer
Model : 51
Manufacturer : Thermo Environmental
Serial No. : 51HT-73244-373

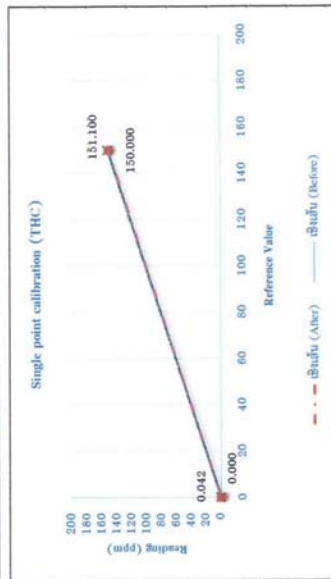
Environmental
Temperature : 24.7 °C
Humidity : 54.4 %RH

Calibration System

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

Certificate No. : 0123-002
Page : 1/1

Calibrated Date : 30-Jan-23
Analyzer Instruments : THC Analyzer
Model : Series 8600
Manufacturer : Baseline
Serial No. : 584

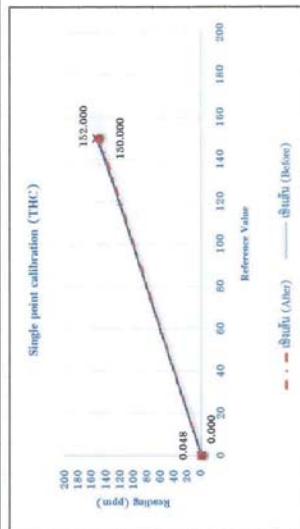
Environmental
Temperature : 24.5 °C
Humidity : 56.3 %RH

Calibration System

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



FORTH CALIBRATION & SERVICE CO., LTD.
305/47 Sor 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



ANAB
ACCREDITED
ILAC-MRA
CALIBRATION LABORATORY
AC-3041

CERTIFICATE OF CALIBRATION

Certificate No. : 66S0330-8

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. : 820892	Date of received : 08-Mar-2023
Identity No. : NS-12-003	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 Phannangkuw (MD)

✓ [] Mr. Boonyarit Auejirakarn

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	94.1	0.1	0.20
	104	104.0	0.0	0.20
	114	114.0	0.0	0.20
B	94	93.8	-0.2	0.00
	104	103.7	-0.3	0.00
	114	113.7	-0.3	0.00
Z	94	93.9	-0.1	0.00
	104	103.9	-0.1	0.00
	114	113.9	-0.1	0.00

UUC* = Unit Under Calibration

- The End -

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. : 820891 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 :

Ms. Bhacharin Phannangkaew (MD)

Reviewed By : Mr. Sompong Srisert

Mr. Boonyarit Auejirakarn

Ms. Natthaprakarn Thammaphan

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 -

CERTIFICATE OF CALIBRATION

Certificate No. : 66S0330-3

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 : ACO

Relative humidity : (50 ± 15) %

Model : 6236

Atmospheric pressure : -

Serial No. : 222195

Date of received : 08-Mar-2023

Identity No. : NS-03-025

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	EELBP.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 :

[] Ms. Bhacharin Phanangkaw (MD)

Reviewed By : [] Mr. Sompong Srisert

[] Mr. Boonyarit Auejirakarn

[] Ms. Natthaparakarn Thammaphan

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	104.0	0.0	0.20
	114	113.7	-0.3	0.20
C	94	94.1	0.1	0.20
	104	104.0	0.0	0.20
	114	114.0	0.0	0.20
Z	94	94.3	0.3	0.20
	104	104.3	0.3	0.20
	114	114.3	0.3	0.20

UUC* = Unit Under Calibration

- The End -

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, Raikhang, 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	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 :

[] Ms. Bhacharin Phanangkaew (MD)

Reviewed By : [] Mr. Sompong Srisert

[] Mr. Boonyarit Auejirakarn

✓ [] Ms. Natthaprakarn Thammaphan

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

[x] Ms. Natthaparakarn Thammaphan

[] Ms. Bhacharin Phanangkaw (MD)

[x] 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

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : tump@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office

196 Phraonoythin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4

1 / 9

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

2 / 9

๓

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BLMTC.002 Rev.4

Head Office
35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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				
113.97	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 (±dB)	Maximum-permitted uncertainty of measurement (±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 (±dB)	Maximum-permitted uncertainty of measurement (±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

3 / 9

๓

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BLMTC.002 Rev.4

Head Office
35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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

8 / 9

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMBL MTC.002 Rev.4

Head Office
35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : tumpa@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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

9 / 9

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMBL MTC.002 Rev.4

Head Office
35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : tumpa@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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, Nakhornpathom 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 :		Ambient Environment
Description	: Sound Level Meter	Temperature : (23 ± 3) °C
Manufacturer	: ACO	Relative Humidity : (50 ± 15) %
Model	: 6236	Ambient Pressure : (101.325 ± 1.5) kPa
Serial No.	: 222128 (NS-03-013)	
Microphone	: Type 7052NR No.84161	
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 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

1 / 9

17

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMBL/MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rump@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

2 / 9

17

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMBL/MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rump@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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				
113.97	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 (±dB)	Maximum-permitted uncertainty of measurement (±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 (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	16.9	0.10	N/A
C-Weight	21.7	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 (±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

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	122.1	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

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

Date of Calibration : 3 Nov. 2022

7/9

The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMBL/MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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	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 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	89.9	-0.1	+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
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 : 3 Nov. 2022

8/9

The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMBL/MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



NSC-TIS-TIS 17025
CALIBRATION 0037

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0074

MTC No. EEL. BP. 17/1165

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	124.2	-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

Positive	Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	one-half cycle	Negative one-half cycle				
130.0	130.0		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	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by:  (Mr. Pannasit Phasingsri)

Approved by:  (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

9 / 9

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax (66) 0 2577 9009
E-mail : rump@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sri 1C Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4

เอกสารทดสอบเทียบเครื่องมือตรวจวัดความถี่เสียง



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT
975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37
Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280
Tel: +66 2709 4860 Fax: +66 2324 0917

Certificate No.: CP20230148EA
Operation No.: CP2023020060

Certificate of Calibration

Equipment: Vibration Meter

Manufacturer: Instatel

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 Swaksuriyavong)
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

Certificate No.: CP20230148EA

Calibration Report

Equipment: Vibration Meter

Manufacturer: Instatel

Model: Micromate

Serial No.: UM16048

ID No.: VB-01-003

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
8305-001	30120	AV-0013-21	30-May-2023
2525	3016651	AV-0007-22	9-Jun-2023
3560-C	2705645	CO20230003EA	25-Dec-2023
HMT331	K3810009	CD20220120EA	22-Apr-2023

Transmitter

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 ± (%)	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	

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 --

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.



Certificate No.: CP20230080EA

Calibration Report

Equipment: Vibration Meter
Manufacturer: Instantel
Model: Micromate
Serial No.: UM15904
ID No.: V8-01-002
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 ± (%)	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 ± (%)	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	

Remark

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

-- End of Report --

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 --



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT
975 Moo 4, Bangsoo Industrial Estate, Soi 8, Sukhumvit Road km 37
Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280
Tel: +66 2709 4860 Fax: +66 2324 0917

Certificate No.: CP20220309EA
Operation No.: CP2022090011

Certificate of Calibration

Equipment: Vibration Meter
Manufacturer: Instantel
Model/Type: Micromate
Serial No.: UM14163
ID No.: VB-01-001
Customer: C.E.M. Technology (Thailand) Co.,Ltd.
Address: 31/8 Moo 13 T.Rai Khung, A.Sam Phran,
Nakorn Phatom 73210
Received Date: 15 September 2022
Calibrated Date: 4 - 6 October 2022
Issued Date: 12 October 2022
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

Certificate No.: CP20220309EA

Calibration Report

Equipment: Vibration Meter
Manufacturer: Instantel
Model: Micromate
Serial No.: UM14163
ID No.: VB-01-001
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	2708237	AV-0010-21	30-Nov-2022
2) Measuring Amplifier	2525	3016651	AV-0007-22	9-Jun-2023
3) PULSE Multi-analyzer system	3050-A-060	2705645	CQ20210015EA	1-Dec-2022
4) Pressure 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.:

CP202020309EA

CP202020309EA

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	9.993	9.553	-0.440	1.5	Longitudinal (L)
5.0	10	9.994	9.742	-0.252	1.5	
6.3	10	10.013	10.049	0.036	1.5	
8.0	10	10.007	9.915	-0.092	1.5	
10.0	10	9.996	9.931	-0.065	1.5	
12.5	10	9.998	9.892	-0.106	1.5	
16.0	10	10.011	9.947	-0.064	1.5	
	20	19.983	19.917	-0.066	1.5	
	30	29.995	29.904	-0.091	1.5	
	50	50.021	49.955	-0.066	1.5	
20.0	10	10.001	9.939	-0.062	1.5	
25.0	10	9.997	9.947	-0.050	1.5	
31.5	10	9.997	9.907	-0.090	1.5	
40.0	10	10.010	9.876	-0.134	1.5	
50.0	10	10.015	9.837	-0.178	1.5	
52.0	10	10.008	9.789	-0.219	1.5	
63.0	10	10.013	9.781	-0.232	1.5	
80.0	10	10.001	9.710	-0.291	1.5	

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	9.984	9.671	-0.313	1.5	Transverse (T)
5.0	10	10.024	9.876	-0.148	1.5	
6.3	10	9.989	10.223	0.234	1.5	
8.0	10	9.996	10.049	0.053	1.5	
10.0	10	10.010	10.112	0.102	1.5	
12.5	10	10.003	10.057	0.054	1.5	
16.0	10	10.008	10.018	0.010	1.5	
	20	19.997	20.107	0.110	1.5	
	30	29.995	30.116	0.121	1.5	
	50	49.978	50.239	0.261	1.5	
20.0	10	9.997	9.978	-0.019	1.5	
25.0	10	9.994	9.963	-0.031	1.5	
31.5	10	9.996	9.900	-0.096	1.5	
40.0	10	10.008	9.829	-0.179	1.5	
50.0	10	10.013	9.750	-0.263	1.5	
52.0	10	10.001	9.758	-0.243	1.5	
63.0	10	9.997	9.734	-0.263	1.5	
80.0	10	9.990	9.742	-0.248	1.5	



Certificate No.:

CP202020309EA

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	10.004	9.797	-0.207	1.5	Vertical (V)
5.0	10	9.998	10.010	0.012	1.5	
6.3	10	10.003	10.428	0.425	1.5	
8.0	10	10.007	10.357	0.350	1.5	
10.0	10	10.004	10.388	0.384	1.5	
12.5	10	10.004	10.357	0.353	1.5	
16.0	10	10.004	10.333	0.329	1.5	
	20	19.997	20.832	0.835	1.5	
	30	30.010	31.173	1.163	1.5	
	50	49.964	51.957	1.993	1.5	
20.0	10	10.000	10.317	0.317	1.5	
25.0	10	10.001	9.931	-0.070	1.5	
31.5	10	10.001	10.215	0.214	1.5	
40.0	10	10.006	10.278	0.272	1.5	
50.0	10	10.003	10.357	0.354	1.5	
52.0	10	9.983	10.396	0.413	1.5	
63.0	10	9.977	10.483	0.506	1.5	
80.0	10	10.020	11.775	1.755	1.5	

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: UM21467
Calibration Date: MAY 29 2003
Calibration Reference Equipment: 71417403

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.

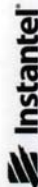
Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology, or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

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:

Xiaoming Yang



309 Legget Drive, Ottawa, Ontario, K2K 3A3, (613) 592-4642



Merci d'avoir choisi Instantel!

Votre engagement avec
« **les moniteurs les plus fiables au monde** »
vous servira pour les années à venir.

Grâce à votre achat, vous êtes à la pointe de la technologie en matière de moniteurs. Au nom de tous les collaborateurs d'Instantel, nous vous remercions d'avoir fait choisir nos produits pour la réalisation de vos projets. Les produits Instantel incluent les éléments les plus aboutis du domaine tels que:

- 1) Plus de 30 années au service des secteurs du bâtiment, d'activités minières et de géotechnologie
- 2) Des conceptions durables et résistantes
- 3) Des produits faciles à utiliser grâce à une interface intuitive
- 4) Des options étendues de conformité réglementaire
- 5) Un programme d'assistance, un service technique et une aide en ligne complets
- 6) Logiciel THOR® disponible en téléchargement gratuit sur le site Web d'Instantel: www.instantel.com
- 7) Garantie d'un an sur les pièces; si un moniteur ou un capteur est ramené à l'usine pour étalonnage jusqu'à un an après la date d'achat, la garantie sera automatiquement prolongée d'un an supplémentaire

Instantel est RESPECTUEUX DE L'ENVIRONNEMENT! Instantel n'envoie plus de manuels en version papier. Les manuels de l'opérateur pour chaque produit et pour THOR sont disponibles en téléchargement sur le site Web d'Instantel à l'adresse www.instantel.com/resources.

Nous nous engageons pour que votre satisfaction en tant que client soit la meilleure possible. En cas de questions ou de commentaires, n'hésitez pas à nous contacter. Veuillez appeler notre numéro gratuit **+1 800 267 9111** ou nous envoyer un e-mail à service@instantel.com ou sales@instantel.com.

Nous vous remercions de nouveau et avons hâte de collaborer avec vous!

© 2018 Xmark Corporation. Instantel et son logo sont des marques déposées de Stanley Black & Decker, Inc. ou de ses filiales. 720U0201 R4v 05.

Calibration Certificate

Part Number: 721A2601
Description: Micromate with DIN Geophone
Serial Number: UM20453
Calibration Date: April 21, 2023
Calibration Reference Equipment: SRV-AFR 714J7401
*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

© 2022 Xmark Corporation. Instantel and Instantel logo are trademarks of Stanley Black & Decker or its affiliates. 71405201 Rev 19

Frequency Response of UM20453 (As Found)

