

ภาคผนวก ง

ใบแสดงการตรวจเทียบเครื่องมือ

ANALYTICAL BALANCE (DU)


Model : XS205 DU

Serial No. : 1126323724



Accuracy Calibration Certificate

Customer

Company: EASTERN THAI CONSULTING 1992 CO., LTD.
Address: 683 Moo 11, Sukhaphiban 8 Rd., Nong Kham
City: Sriracha Contact: Sasiporn Nakin
Zip / Postal: 20230
State / Province: Chonburi
Order Number: 

Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: XS205DU Asset Number: LABE 05/1
Serial No.: 1126323724 Terminal Model: SAT
Building: Laboratory Terminal Serial No.: 1126323724
Floor: 1 Terminal Asset No.: N/A
Room: Laboratory

Range	Max. Capacity	Readability (d)
1	81 g	0.00001 g
2	220 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction: CP/W002/20

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature	Humidity
As Found	Start: 26.9 °C End: 26.8 °C	Start: 73.8 % End: 71.9 %

As Found Calibration Date: 22-Jul-2021
As Left Calibration Date: N/A
Issue Date: 23-Jul-2021

Calibrator:

Patipat Swealpanuwat

Approved Signatory:

☒ Kassakorn Tassanachaisakul
☐ Santi Jitniyom
☐ Surachet Sukkate

Measurement Results

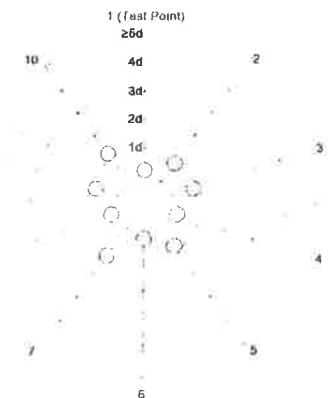
Repeatability

Test Load: 70 g

	As Found	As Left
1	69.99998 g	N/A
2	69.99997 g	N/A
3	69.99997 g	N/A
4	69.99998 g	N/A
5	69.99997 g	N/A
6	69.99998 g	N/A
7	69.99999 g	N/A
8	69.99998 g	N/A
9	69.99997 g	N/A
10	69.99999 g	N/A

Standard Deviation	0.000008 g	N/A
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As Found
As Left



The "d" in the graph represents the readability of the range/interval in which the test was performed.

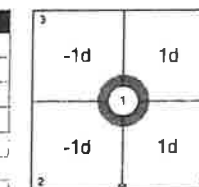
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	99.9999 g	N/A
2	99.9998 g	N/A
3	99.9998 g	N/A
4	100.0000 g	N/A
5	100.0000 g	N/A

Maximum Deviation	0.0001 g	N/A
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As Found

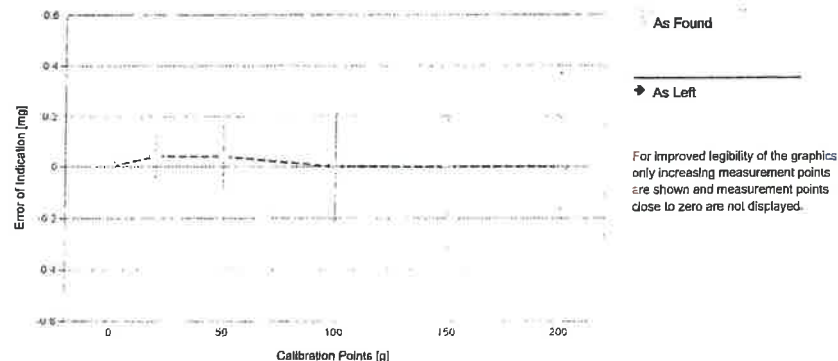
The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.00000 g	0.00000 g	0.00000 g	0.017 mg	2
2	0.01000 g	0.01000 g	0.00000 g	0.019 mg	2
3	0.10000 g	0.09999 g	-0.00001 g	0.023 mg	2
4	1.00000 g	1.00000 g	0.00000 g	0.032 mg	2
5	4.99998 g	5.00000 g	0.00002 g	0.048 mg	2
6	9.99999 g	10.00001 g	0.00002 g	0.061 mg	2
7	20.00001 g	20.00005 g	0.00004 g	0.082 mg	2
8*	49.99993 g	49.99997 g	0.00004 g	0.12 mg	2
9	99.9999 g	99.9999 g	0.0000 g	0.21 mg	2
10	149.9998 g	149.9998 g	0.0000 g	0.32 mg	2
11	199.9998 g	199.9998 g	0.0000 g	0.37 mg	2

*The calculated uncertainty was replaced by the CMC (Calibration and Measurement Capabilities) value because the calculated uncertainty was smaller than the CMC value.



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.: WS28 Date of Issue: 17-Nov-2020
Certificate Number: 170241 Calibration Due Date: 15-May-2022

Thermo Hygrometer

Equipment No.: IN51 Date of Issue: 02-Mar-2021
Certificate Number: 21H403 Calibration Due Date: 23-Feb-2022

Remarks

FACT adjustment functionality activated
Equipment condition: Good
Next calibration according to customer's procedure

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

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Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with $k=2$ in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: $1.5 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: 5 K

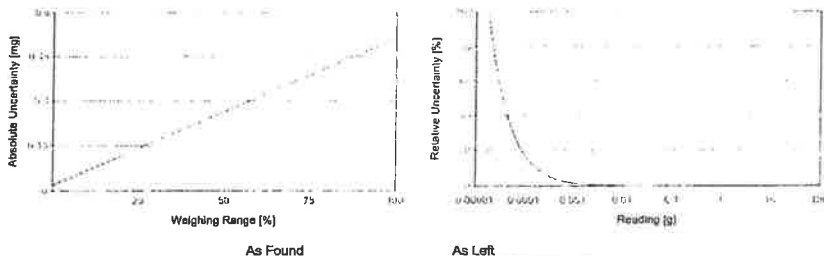
Linearization of Uncertainty Equation

	Range		As Found	As Left
d	Max			
1	0.00001 g	81 g	$U_1 = 0.018 \text{ mg} + 0.00608 \text{ mg/g} \cdot R$	N/A
2	0.0001 g	220 g	$U_2 = 0.06 \text{ mg} + 0.00603 \text{ mg/g} \cdot R$	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
0.00220 g	0.018 mg	0.82%	N/A	N/A
0.02200 g	0.018 mg	0.082%	N/A	N/A
0.22000 g	0.019 mg	0.0088%	N/A	N/A
2.20000 g	0.031 mg	0.0014%	N/A	N/A
220.0000 g	1.4 mg	0.00063%	N/A	N/A



The weighing range shown in the absolute uncertainty graph refers to the first interval/range of the device.

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GWP® Certificate



As
Found



As
Left



The weighing device meets the given process requirements.

The weighing device meets the given process requirements.

Tests Performed: ☒ As Found ☐ As Left ☐ No adjustments/modifications made. As Left results correspond to As Found.

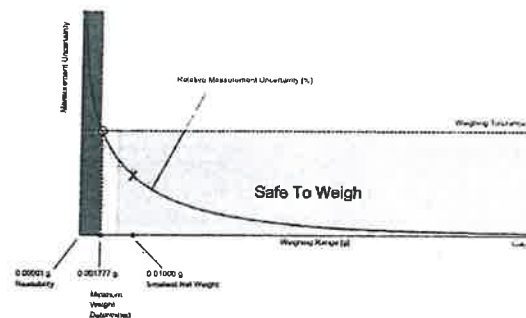
Process Requirements

Weighing Tolerance: 1%

Smallest Net Weight: 0.01000 g

Safety Factor: 2

Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

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Minimum Weight

As Found Minimum Weight Table

Range 1

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.017873 g	0.035965 g	0.054282 g	0.091605 g	0.189140 g
0.2%	0.008909 g	0.017873 g	0.026891 g	0.045095 g	0.091605 g
0.5%	0.003557 g	0.007123 g	0.010697 g	0.017873 g	0.035965 g
1%	0.001777 g	0.003557 g	0.005339 g	0.008909 g	0.017873 g
2%	0.000888 g	0.001777 g	0.002667 g	0.004448 g	0.008909 g
5%	0.000355 g	0.000711 g	0.001066 g	0.001777 g	0.003557 g

The minimum weight table applies to the fine range of the weighing device.

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

As Left Minimum Weight Table

Range 1

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.017873 g	0.035965 g	0.054282 g	0.091605 g	0.189140 g
0.2%	0.008909 g	0.017873 g	0.026891 g	0.045095 g	0.091605 g
0.5%	0.003557 g	0.007123 g	0.010697 g	0.017873 g	0.035965 g
1%	0.001777 g	0.003557 g	0.005339 g	0.008909 g	0.017873 g
2%	0.000888 g	0.001777 g	0.002667 g	0.004448 g	0.008909 g
5%	0.000355 g	0.000711 g	0.001066 g	0.001777 g	0.003557 g

The minimum weight table applies to the fine range of the weighing device.

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with $k = 2$ and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

Notes on minimum weight values in above table:

- If "N/A" is shown above, no appropriate value could be calculated.
- METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

	Repeatability	Eccentricity	Error of indication
As Found	✓	✓	✓
As Left	✓	✓	✓

✓ = Passed

✗ = Failed

NA = Safety Factor not met

Repeatability

Test Load: 70 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	0.000005 g	0.000008 g	✗	0.000008 g	✗
0.2%	0.000010 g		✓		✓
0.5%	0.000025 g		✓		✓
1%	0.000050 g		✓		✓
2%	0.000100 g		✓		✓
5%	0.000250 g		✓		✓

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 g		✓		✓
1%	0.5000 g		✓		✓
2%	1.0000 g		✓		✓
5%	2.5000 g		✓		✓

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

Attachment to Calibration Certificate:

TH2046-059-072221-ACC-TH

GWP® Certificate

Error of Indication

METTLER TOLEDO Service

As Found

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.00000 g	0.00000 g	N/A	N/A	N/A	N/A	N/A	N/A
20.00001 g	0.00004 g	0.01000 g	0.02000 g	0.05000 g	0.10000 g	0.20000 g	0.50000 g
49.99993 g	0.00004 g	0.02500 g	0.05000 g	0.12500 g	0.25000 g	0.50000 g	1.25000 g
99.9999 g	0.0000 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
149.9998 g	0.0000 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
199.9998 g	0.0000 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

As Left

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.00000 g	0.00000 g	N/A	N/A	N/A	N/A	N/A	N/A
20.00001 g	0.00004 g	0.01000 g	0.02000 g	0.05000 g	0.10000 g	0.20000 g	0.50000 g
49.99993 g	0.00004 g	0.02500 g	0.05000 g	0.12500 g	0.25000 g	0.50000 g	1.25000 g
99.9999 g	0.0000 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
149.9998 g	0.0000 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
199.9998 g	0.0000 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.

Service Date: 2021-07-22

Document Number: TH2046-542-072221-LABBalanceHR

EASTERN THAI CONSULTING 1992 CO., LTD.

683 Moo 11, Sukhaphiban 8 Rd., Nong Kham, Sriracha, Chonburi 20230

Sasiporn Nakin

METTLER TOLEDO

Balance Health Report

Device Details

System Details			
Manufacturer:	Mettler Toledo	Accessory 1:	
Model:	XS205DU	Accessory 2:	
Serial number:	1126323724	Weight set for routine testing:	Yes /
Firmware:	4.00 / 5.61		

History

Device History		Service History	
Instrument in use:	Yes	Last preventive maintenance:	< 1 year
Instrument age:	> 10 years	Last instrument calibration:	< 1 year
Spare parts available:	Yes	Last minimum weight determination:	Never
Regulations:	ISO		
Process tolerance in %:	1%		
Smallest sample net weight:	0.01000 g	Routine testing performed:	Yes

Check List

Environmental Conditions		General & Functional Checks	
Room temperature fluctuation	✓	Levelling	✓
Exposure to direct sun	✓	Cleanliness	✓
Vibrations	✓	Completeness - missing parts see additional remarks	✓
Draft	✓	Settings optimized for operating environment	✓
Dirt or dust	✓	Other - objections noted as additional remarks	—
Static	✓	Electrical Component Checks	
Mechanical Component Checks		Power supply	✓
Draft shield	✓	Sliding door drive	—
Weighing pan position	✓	Internal weight drive	✓
Housing	✓	Display	✓
Other - objections noted as additional remarks	—	Other - objections noted as additional remarks	—

Recommendations

Measurement Result Quality		Process Efficiency	
Instrument calibration		Uninstall instrument	
Identify safe weighing range		Replace instrument	
GWP verification / risk assessment	Yes	Replace / add parts (see additional remarks)	
Preventive maintenance		Onsite repair	
Perform routine testing with test weights		Depot repair	
User training		Use of accessories (see additional remarks)	

Contact	Name: Sasiporn Nakin	Position:	Phone: 0960513303	Email: dc_lab@etc1992.com
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Additional Remarks & Recommendations		Engineer Details	
		Date:	22-Jul-2021
		Name:	Patipat Sweatpanuwat
		Signature:	

This is not a certificate.

It should not be used to interpret final results for the testing of these devices.

Legend: ✓ Good/Pass ▲ Needs Attention ✗ Bad/Fail — Not Applicable

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www.mt.com

METTLER TOLEDO Service

Report Version: 1.13, Software Version 4.20.0.3, Page 1/1, © METTLER TOLEDO

ANALYTICAL BALANCE

Model : SECURA224-1S

Serial No. : 0036707137



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NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-013243
Sample code : 21-05951-007

Page 1 of 4

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of calibration : EASTERN THAI CONSULTING 1992 CO., LTD.
(Analytical Balance Room)

Equipment : ELECTRONIC BALANCE

Manufacturer : SARTORIUS

Model : SECURA224-1S

Serial No. : 0036707137

ID No. : LABE 05/2

Date of Receipt : 09 February 2021

Date of Calibration : 09 February 2021

Calibrated by Mr. Pattarakorn Panklong
Scientist

Approved by (Mr. Somchai Neampunt)
Signed for Director

Date of Issue : 18 February 2021

The uncertainties are for a confidence probability of approximately 95%

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Co., Ltd. (AMARC)



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NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-013243
Sample code : 21-05951-007

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REPORT OF CALIBRATION

Equipment : ELECTRONIC BALANCE

Manufacturer : SARTORIUS

Model : SECURA224-1S

Capacity : Max 220 g

Resolution : 0.0001 g

Serial No. : 0036707137

ID No. : LABE 05/2

Result of Calibration :

1. Test weight and repeatability of reading

Repeatability is a measure of the ability of a balance to supply the same result in repetitive weighings with one and the same load under the same measurement condition. The measurement of the repeatability must include both the balance specifications and the ambient (vibration, fluctuating air current/temperature/humidity, etc.) Operator handling of the balance is also included in the standard deviation.

Unit : g	Range : 220	<input type="checkbox"/> Before adjustment	<input type="checkbox"/> After adjustment
<input checked="" type="checkbox"/> No adjustment	Nominal value	100	200
<input type="checkbox"/> Adjustment	Standard weight	99.999959	199.999922
	Average reading of indicator	99.9998	199.9998
	Standard deviation	0.00005	0.00005

Unit : -	Range : -	<input type="checkbox"/> Before adjustment	<input type="checkbox"/> After adjustment
<input type="checkbox"/> No adjustment	Nominal value	-	-
<input type="checkbox"/> Adjustment	Standard weight	-	-
	Average reading of indicator	-	-
	Standard deviation	-	-

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NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-013243
Sample code : 21-05951-007

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REPORT OF CALIBRATION

Result of Calibration :

2. Sensitivity or value of a scale division

Change in the output variable of a measuring Instrument divided by the associated change in the input variable.

Unit : g

Range : 220

Range : -

Test Point	Sensitivity, S	Test Point	Sensitivity, S
0	1.00	-	-
100	1.00	-	-
200	1.00	-	-

3. Departure of indication from nominal value, Linearity

Unit : g

Nominal Value	Standard Value	Average Reading of Indicator	Correction Value	Expanded Uncertainty	Coverage Factor (k)
Unload*	0.0000000	0.0000	0.0000	0.000094	2.01
0.01	0.0100020	0.0100	0.0000	0.000094	2.01
0.1	0.0999987	0.1000	0.0000	0.000094	2.01
1	1.0000133	1.0000	0.0000	0.000095	2.01
2	2.0000023	2.0000	0.0000	0.000095	2.01
5	4.9999988	5.0000	0.0000	0.000096	2.01
10	10.000007	10.0000	0.0000	0.000097	2.01
20	19.999989	20.0000	0.0000	0.00010	2.01
50	49.999972	50.0000	0.0000	0.00012	2.01
100	99.999959	99.9999	0.0001	0.00016	2.00
200	199.999922	199.9998	0.0001	0.00028	2.00

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003

Remark

* = Calibrations marked "Not Accredited" in this Certificate have been included for completeness.

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NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-013243
Sample code : 21-05951-007

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REPORT OF CALIBRATION

Result of Calibration :

4. Eccentric or off-centre loading

Deviation of the measurement value through off - center (eccentric) loading. The corner load increases with the weight of the load and its removal from the center of the pan support.

☒ Circle

Weighing pan

☐ Triangular

☐ Rectangular

Test weight : 100

Unit : g

Range

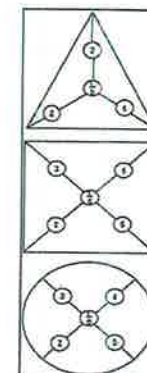
220

Position

Reading of indicator

Reading of indicator

1	99.9998	-
2	99.9999	-
3	99.9998	-
4	99.9997	-
5	99.9998	-
6	99.9998	-
Maximum difference	0.0001	-



Condition of Calibration

- Calibration Method : WI-CL-004 base on UKAS LAB 14 : 2019
- This result of calibration was found accurate as shown on date and place of calibration only.
- Reference standard instrument :

Instrument

Class

ID. No.

1) STANDARD WEIGHT 1 mg to 1 kg E2 LB-WE-49

Ambient Conditions	Min	Max
Temperature (°C)	24.7	25.0
Relative Humidity (%Rh)	51.0	58.8
Air pressure (hPa)	1009.0	1009.8

Certificate No.

Due date

20-116015

28 December 2021

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

- Through the reference standard laboratory of Asia Medical and Agricultural Laboratory and Research Center Co., Ltd.

(Instrument number 1).

- Condition of Calibration item : Normal

End of Report

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ANALYTICAL BALANCE

Model : SECURA224-1S

Serial No. : 0036707137



Certificate No. : 22-011768
Sample Code : 22-04498-005

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
683 Moo 11, Sukhepiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of Calibration : EASTERN THAI CONSULTING 1992 CO., LTD.
(Analytical Balance Room)

Equipment : ELECTRONIC BALANCE

Manufacturer : SARTORIUS

Model : SECURA224-1S

Serial No. : 0036707137

ID No. : LABE 05/2

Date of Receipt : 03 February 2022

Date of Calibration : 03 February 2022

Calibrated by : Mr. Thanadol Pholthep
Scientist

Approved by : (Mr. Somchai Neampunt)

Signed for Director

Issue date : 07 February 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).



Certificate No. : 22-011768
Sample Code : 22-04498-005

REPORT OF CALIBRATION

Equipment : ELECTRONIC BALANCE
Manufacturer : SARTORIUS
Model : SECURA224-1S
Capacity : Max 220 g
Resolution : 0.0001 g
Serial No. : 0036707137
ID No. : LABE 05/2

Result of Calibration

1. Test weight and repeatability of reading

Repeatability is a measure of the ability of a balance to supply the same result in repetitive weighings with one and the same load under the same measurement condition. The measurement of the repeatability must include both the balance specifications and the ambient (vibration, fluctuating air current/temperature/humidity, etc.) Operator handling of the balance is also included in the standard deviation.

Unit : g	Range : 220	<input checked="" type="checkbox"/> Before adjustment	<input checked="" type="checkbox"/> After adjustment
<input type="checkbox"/> No adjustment	Nominal value	100	200
<input checked="" type="checkbox"/> Adjustment	Standard weight	100.000022	200.000141
	Average reading of indicator	99.9998	199.9998
	Standard deviation	0.00009	0.00005

Unit : -	Range : -	<input type="checkbox"/> Before adjustment	<input type="checkbox"/> After adjustment
<input type="checkbox"/> No adjustment	Nominal value	-	-
<input type="checkbox"/> Adjustment	Standard weight	-	-
	Average reading of indicator	-	-
	Standard deviation	-	-

Certificate No. : 22-011768
Sample Code : 22-04498-005

REPORT OF CALIBRATION

Result of Calibration

2. Sensitivity or value of a scale division

Change in the output variable of a measuring instrument divided by the associated change in the input variable.

Unit : g

Range : 220

Range : -

Test Point	Sensitivity, S	Test Point	Sensitivity, S
0	0.7981	-	-
100	0.9976	-	-
200	0.9976	-	-

3. Departure of indication from nominal value, Linearity

Unit : g

Nominal Value	Standard Value	Average Reading of Indicator	Correction Value	Expanded Uncertainty	Coverage Factor (k)
Unload	0.0000000	0.0000	0.0000	0.000094	2.01
0.01	0.0100045	0.0100	0.0000	0.000094	2.01
0.1	0.1000102	0.1000	0.0000	0.000094	2.01
1	1.0000055	1.0000	0.0000	0.000095	2.01
2	2.0000144	1.9999	0.0001	0.000095	2.01
5	5.0000060	5.0000	0.0000	0.000096	2.01
10	10.000017	9.9999	0.0001	0.000097	2.01
20	20.000022	20.0000	0.0000	0.00010	2.01
50	50.000038	50.0000	0.0000	0.00012	2.01
100	100.000022	99.9999	0.0001	0.00016	2.00
200	200.000141	200.0000	0.0001	0.00027	2.00

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003.

Certificate No. : 22-011768
Sample Code : 22-04498-005

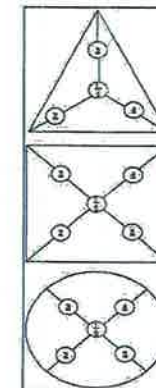
REPORT OF CALIBRATION

Result of Calibration :

4. Eccentric or off-centre loading

Deviation of the measurement value through off - center (eccentric) loading. The corner load increases with the weight of the load and its removal from the center of the pan support.

Weighing pan	<input checked="" type="radio"/> Circle <input type="radio"/> Triangular <input type="radio"/> Rectangular	Test weight : 100 Unit : g
Range	220	
Position	Reading of indicator	Reading of indicator
1	99.9999	-
2	100.0000	-
3	99.9999	-
4	99.9997	-
5	100.0000	-
6	99.9999	-
Maximum difference	0.0002	-



Condition of Calibration

1. Calibration Method : WI-CL-004 base on UKAS LAB 14: 2019
2. This result of calibration was found accurate as shown on date and place of calibration only.
3. Condition of Calibration item: Normal
4. This certification is traceable to the International System of Unit maintained at :-
- Through the reference standard laboratory of Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (Instrument number 1).
5. Reference standard instrument :

Ambient conditions	Min	Max
Temperature (°C)	24.9	26.7
Relative Humidity (%Rh)	40.3	55.6
Air pressure (hPa)	1009.3	1010.7

Instrument	Class	ID No.	Certificate No.	Due Date
1) STANDARD WEIGHT 1 mg to 1 kg	E2	LB-WE-57	21-055461	29 June 2022

- End of Report -

BAROMETER

Equipment : Analog Barometer

ID No. / Tag No. : BM001/41



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD

214 Bangwack Rd. Bangpai Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 http://www.mit.in.th



CALIBRATION CERTIFICATE

Certificate No. : AD2106-032-0001

Date Issued : 04-Jun-21

Customer : Eastern Thai Consulting 1992 Co., Ltd.
683 Moo 11 Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

Equipment : Analog Barometer

Manufacturer : Barigo

Model : -

Serial No. : -

ID No./Tag No. : BM001/41

Date Received : 02-Jun-21

Date Calibrated : 04-Jun-21

Calibrated by : Mr. Somjet Onbua

Calibration Method or Calibration Procedure Used

In-house method : CP-21 base on DKD-R 6-1: Edition 3 2014.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

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

This certificate may not be reproduced other than in full except with the prior written approval of the Technical Manager, Miracle International Technology Company Limited.

Approved by :

(Mr. Tassanai Suksukon)
Technical Manager



Page 1 of 2

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Certificate No : AD2106-032-0001

Environment Ambient Temperature : $(25 \pm 2)^{\circ}\text{C}$
Relative Humidity : $(50 \pm 15)\%\text{RH}$

STD Reading	UUC Reading (hPa)	UUC Reading (hPa)	UUC Error	Uncertainty
hPa	Before Adjusted	After Adjusted	hPa	\pm hPa
990.00	990.0	-	0.00	0.91
1000.00	1000.0	-	0.00	0.91
1010.00	1010.0	-	0.00	0.91
1020.00	1020.0	-	0.00	0.91
1030.00	1030.0	-	0.00	0.91

STD = Standard

UUC = Unit Under Calibration

Calibrated condition : Pressure Medium Air : Density = 1.19 kg/m^3 @ 20°C , 1 bar
Mounting Position Vertical
Reference Level at center of its dial

Description of UUC : Range 955 - 1075 hPa Absolute
Calibration Range 990 - 1030 hPa Absolute
Scale Interval 1 hPa
Resolution 0.5 hPa Absolute

Measurement Standards Used & Traceability :

The International System of Units (SI) through

IRPC Certificate No. CL1-P210029 for Digital Barometer Serial No. 290185, Due 19-Oct-21

End of Certificate

Page 2 of 2

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BAROMETER

Equipment : Analog Barometer

ID No. / Tag No. : BM001/41



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD

214 Bangwaek Rd. Bangpai Bangkok 10160

Tel.: 0-2865-4647-8 Fax: 0-2865-4649 http://www.mit.in.th



CALIBRATION CERTIFICATE

Certificate No. : AD2205-163-0001

Date Issued : 20-May-22

Customer : Eastern Thai Consulting 1992 Co., Ltd.
683 Moo 11 Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

Equipment : Analog Barometer

Manufacturer : Barigo

Model : -

Serial No. : -

ID No./Tag No. : BM001/41

Date Received : 12-May-22

Date Calibrated : 20-May-22

Calibrated by : Mr. Saruth Srichutikul

Calibration Method or Calibration Procedure Used

In-house method : CP-21 base on DKD-R 6-1: Edition 3 2014.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

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

This certificate may not be reproduced other than in full except with the prior written approval of the Miracle International Technology Company Limited.

Approved by:

K. Nathong

(Mr. Nathapong Krudaum)



Page 1 of 2

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Certificate No : AD2205-163-0001

Environment Ambient Temperature : $(25 \pm 2)^{\circ}\text{C}$

Relative Humidity : $(50 \pm 15)\%\text{RH}$

STD Reading	UUC Reading (hPa)	UUC Reading (hPa)	UUC Error	Uncertainty
hPa	Before Adjusted	After Adjusted	hPa	\pm hPa
990.00	990.0	-	0.00	0.59
1000.00	1000.0	-	0.00	0.59
1010.00	1010.0	-	0.00	0.59
1020.00	1020.0	-	0.00	0.59
1030.00	1030.0	-	0.00	0.59

STD = Standard

UUC = Unit Under Calibration

Calibrated condition : Pressure Medium Air : Density = 1.19 kg/m^3 @ 20°C , 1 bar
Mounting Position Vertical
Reference Level at center of its dial

Description of UUC : Range 955 - 1075 hPa Absolute
Calibration Range 990 - 1030 hPa Absolute
Scale Interval 1 hPa

Resolution 0.5 hPa Absolute

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

iRPC Certificate No. CL1-P210086 for Reference Pressure Monitor Serial No. 1598, Due 08-Nov-22

End of Certificate

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Page 2 of 2

BOD INCUBATOR

ID No. : LABE 19/1

NSC-TISI-TIS17025
CALIBRATION 0152

Page 1 of 3

CERTIFICATE OF CALIBRATION

Certificate No. : 22-007487

Sample Code : 22-02978-006

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of Calibration : EASTERN THAI CONSULTING 1992 CO., LTD.
(Laboratory)

Equipment : Temperature controlled enclosures (Incubator)

Manufacturer : N/A **Model** : N/A

Serial No. : S540040277 **ID No.** : LABE 19/2

Date of Receipt : 24 January 2022 **Date of Calibration** : 24 January 2022

Condition of Calibration

- 1. Environment**
- | | | | | |
|---------------------------|-----------|-----------|-----------|-----------|
| 1.1 Ambient temperature | : Maximum | 30.4 °C | : Minimum | 30.0 °C |
| 1.2 Relative humidity | : Maximum | 51.2 % | : Minimum | 46.2 % |
| 1.3 Line voltage supplied | : Maximum | 225.3 VAC | : Minimum | 224.1 VAC |

2. Calibration method

TLAS-G-20: Guidelines for calibration and checks of temperature controlled enclosures.

3. Reference standard instrument

Instrument	ID No.	Certificate No.	Due Date
Data acquisition with sensor (RTD-Pt100)	LB-DA-12 (RTD-158 to RTD-166)	21-038920	10 May 2022

4. This certificate is traceable to the international system of unit (SI Unit).

The measurement is traceable to Asia Medical and Agricultural Laboratory and Research Center Public Company Limited.

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

6. Condition of calibration item : Normal

Calibrated by Mr. Pattarakorn Panklong
Scientist

Approved by (Mr. Somchai Neampunt)
Signed for Director

Issue date 28 January 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).

NSC-TISI-TIS17025
CALIBRATION 0152

Page 2 of 3

REPORT OF CALIBRATION

Certificate No. : 22-007487

Sample Code : 22-02978-006

Results of Calibration

Resolution : 0.1 °C

1. Reporting of Temperature

Calibration point (°C)	UUC* setting (°C)	UUC* reading (°C)	Measured temperature at each positions (°C)									Uncertainty ± (°C)	Coverage factor k
			#1	#2	#3	#4	#5	#6	#7	#8	#9 ^{Ref}		
20	20.0	20.0	19.61	19.35	19.81	19.37	20.15	20.34	20.14	20.45	19.61	0.30	2.00

2. Characterization results

Calibration point (°C)	Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
20	0.08	0.94	1.22

Notes

- UUC* = Unit Under Calibration

REPORT OF CALIBRATION

Certificate No. : 22-007487

Sample Code : 22-02978-006

Results of Calibration

Notes

1. Sensor installation locations

1.1 All sensors at any corners or walls should be positioned

5 cm (a x b x c) from the wall.

1.2 The reference sensor is preferably located of the geometric center of the chamber.

2. Interior dimensions approx of chamber :

W = 60 cm ; D = 70 cm ; H = 124 cm

3. Air valve or fresh air level : Off

4. Fan level : Open

5. The quoted uncertainty includes "Stability of chamber and loading effect in chamber at 20% of uniformity".

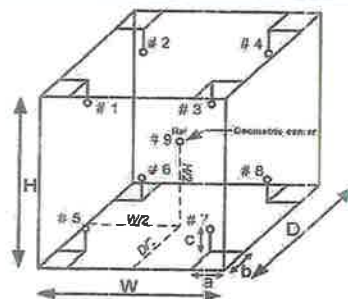
6. Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

7. Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

8. Overall variation - the difference of the maximum and the minimum measured temperatures throughout observation time.

9. UUC* reading - the average reading of indicating device that forms the integral part of the enclosure.

10. Calibration results without adjustment.

Figure: Example of sensor
installation Positions

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003.

- End of Report -

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BOD INCUBATOR

ID No. : LABE 19/2



Page 1 of 3

CERTIFICATE OF CALIBRATION

Certificate No. : 22-007487

Sample Code : 22-02978-006

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.

683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230Location of Calibration : EASTERN THAI CONSULTING 1992 CO., LTD.
(Laboratory)

Equipment : Temperature controlled enclosures (Incubator)

Manufacturer : N/A Model : N/A

Serial No. : S540040277 ID No. : LABE 19/2

Date of Receipt : 24 January 2022 Date of Calibration : 24 January 2022

Condition of Calibration

1. Environment
- 1.1 Ambient temperature : Maximum 30.4 °C ; Minimum 30.0 °C
- 1.2 Relative humidity : Maximum 51.2 % ; Minimum 46.2 %
- 1.3 Line voltage supplied : Maximum 225.3 VAC ; Minimum 224.1 VAC

2. Calibration method

TLAS-G-20: Guidelines for calibration and checks of temperature controlled enclosures.

3. Reference standard instrument

Instrument	ID No.	Certificate No.	Due Date
Data acquisition with sensor (RTD-Pt100)	LB-DA-12 (RTD-158 to RTD-166)	21-038920	10 May 2022

4. This certificate is traceable to the international system of unit (SI Unit).

The measurement is traceable to Asia Medical and Agricultural Laboratory and Research Center Public Company Limited.

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

6. Condition of calibration item : Normal

Calibrated by Mr. Pattarakorn Panklong

Scientist

Approved by

(Mr. Somchai Neampunt)

Signed for Director

Issue date 28 January 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

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Page 2 of 3

REPORT OF CALIBRATION

Certificate No. : 22-007487

Sample Code : 22-02978-006

Results of Calibration

Resolution : 0.1 °C

1. Reporting of Temperature

Calibration point (°C)	UUC* setting (°C)	UUC* reading (°C)	Measured temperature at each positions (°C)									Uncertainty ± (°C)	Coverage factor k
			#1	#2	#3	#4	#5	#6	#7	#8	#9 ^{Ref}		
20	20.0	20.0	19.61	19.35	19.81	19.37	20.15	20.34	20.14	20.45	19.61	0.30	2.00

2. Characterization results

Calibration point (°C)	Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
20	0.08	0.94	1.22

Notes

- UUC* = Unit Under Calibration

REPORT OF CALIBRATION

Certificate No. : 22-007487

Sample Code : 22-02978-006

Results of Calibration

Notes

1. Sensor installation locations
 - 1.1 All sensors at any corners or walls should be positioned 5 cm (a x b x c) from the wall.
 - 1.2 The reference sensor is preferably located of the geometric center of the chamber.
2. Interior dimensions approx of chamber :
W = 60 cm ; D = 70 cm ; H = 124 cm
3. Air valve or fresh air level : Off
4. Fan level : Open
5. The quoted uncertainty includes "Stability of chamber and loading effect in chamber at 20% of uniformity".
6. Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.
7. Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.
8. Overall variation - the difference of the maximum and the minimum measured temperatures throughout observation time.
9. UUC* reading - the average reading of indicating device that forms the integral part of the enclosure.
10. Calibration results without adjustment.

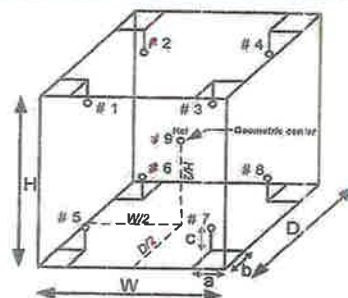


Figure: Example of sensor
Installation Positions

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003.

- End of Report -

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CERTIFICATE OF ANALYSIS

EPA PROTOCOL GAS

Cylinder No. : EB0145030

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E03NI99E15AC0U4 Reference Number: 160-402242242-1
Cylinder Number: EB0145030 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12021 Valve Outlet: 350
Gas Code: CH4,PPN,BALN Certification Date: Oct 15, 2021

Expiration Date: Oct 15, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 000/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
METHANE	180.0 PPM	177.0 PPM	G1	+/- 1.0% NIST Traceable	10/15/2021
PROPANE	185.0 PPM	187.0 PPM	G1	+/- 1.0% NIST Traceable	10/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08011503	K002564	246.7 PPM METHANE/AIR	+/- 0.6%	May 15, 2025
NTRM	200602-06	6162660Y	243.3 PPM PROPANE/AIR	+/- 0.5%	Mar 17, 2027

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet IS50 FTIR AUP2110295 CH4	FTIR	Oct 13, 2021
Nicolet IS50 FTIR AUP2110295 C3H8	FTIR	Oct 14, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.0 Kg
Net Weight: 4.9 Kg
PO# 5221004861



Michael A. Hughes
Approved for Release



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CERTIFICATE OF ANALYSIS

EPA PROTOCOL GAS

Cylinder No. : EB0062815

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15ACX9C Reference Number: 82-401135335-1
Cylinder Number: EB0062815 Cylinder Volume: 144.4 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2015 PSIG
PGVP Number: B52018 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Mar 13, 2018

Expiration Date: Mar 13, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	50.00 PPM	50.55 PPM	G1	+/- 1.4% NIST Traceable	03/06/2018, 03/13/2018
NITRIC OXIDE	50.00 PPM	50.50 PPM	G1	+/- 1.4% NIST Traceable	03/06/2018, 03/13/2018
SULFUR DIOXIDE	50.00 PPM	51.01 PPM	G1	+/- 1.0% NIST Traceable	03/06/2018, 03/13/2018
CARBON MONOXIDE	2000 PPM	1977 PPM	G1	+/- 1.0% NIST Traceable	03/06/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060607	CC442564	50.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
PRM	12367	APEX1099237	9.82 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 02, 2017
GMIS	0315201604	CC503358	4.975 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.6%	Mar 15, 2019
NTRM	16011025	CC473218	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 07, 2022
NTRM	12060735	CC356192	2498 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Dec 14, 2026

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 CO	FTIR	Feb 08, 2018
Nicolet 6700 APW1100391 NO	FTIR	Feb 15, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Feb 16, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Mar 01, 2018

Triad Data Available Upon Request

NOTES:NET WEIGHT: 10.43lbs

GROSS WEIGHT: 60.93lbs

PO# 5218000763

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2000 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Don Harris
Approved for Release

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DRY GAS METER MC-572-V

Serial No. : 1007055

METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961
5-POINT METRIC UNIT

☒ Preventive Maintenance & Check

Meter Console Information	
Console Model Number	MC-572-V
Console Serial Number	1007055
DGM Model Number	SK25EX
DGM Serial Number	0005459

Calibration Conditions			
Date	Time	15-Jun-21	8:30 AM
Calibration Reference No.	GC64APE0037		
Barometric Pressure	751	mm Hg	
Calibration Meter Gamma	0.9980	unless	

Factors/Conversions		
Std Temp	298	K
Std Press	760	mm Hg
K ₁	0.392	

Calibration Data									
Run Time	Metering Console				Calibration Meter				
Elapsed (t)	DGM Orifice (P _o)	Volume Initial (V _{in})	Volume Final (V _{out})	Outlet Temp Initial (t _{in})	Outlet Temp Final (t _{out})	Volume Initial (V _{in})	Volume Final (V _{out})	Outlet Temp Initial (t _{in})	Outlet Temp Final (t _{out})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
15.00	13.0	342.0737	342.2493	25	26	204.97437	205.17455	27	26
10.00	25.0	342.2809	342.4463	26	26	205.21227	205.39526	26	26
8.00	50.0	342.4747	342.6575	26	26	205.42618	205.62204	26	26
7.00	80.0	342.6743	342.8792	26	26	205.63987	205.85738	26	26
5.00	120.0	342.9033	343.0823	26	26	205.88286	206.07264	26	26

Standardized Data				Results			
Dry Gas Meter		Calibration Meter		Calibration Factor		Dry Gas Meter	
(V _{std})	(Q _{std})	(V _{cal})	(Q _{cal})	Value (Y)	Variation (ΔY)	Std & Corr (Q _{std})	ΔH @
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O
0.172	0.011	0.196	0.013	0.985	0.004	0.011	45.997
0.163	0.016	0.180	0.018	0.983	0.002	0.016	44.060
0.181	0.023	0.192	0.024	0.982	0.001	0.022	46.266
0.203	0.029	0.214	0.031	0.979	-0.002	0.028	45.386
0.178	0.036	0.186	0.037	0.978	-0.003	0.035	45.606
				0.981	Y Average		45.463
							ΔH @ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter. The difference of individual values from the average is ± 0.02 .

Note: For ΔH_o, orifice pressure differential that equates to 0.75cfm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

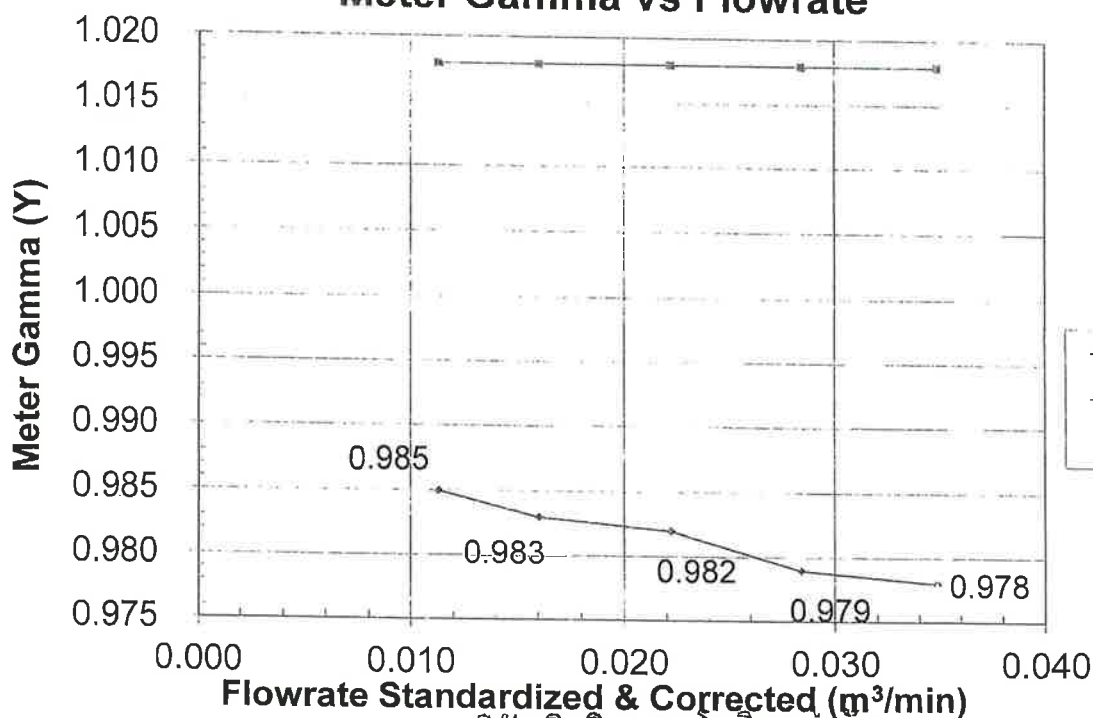
SITHIPORN ASSOCIATES COMPANY LIMITED

Signature Surachai Chaisana
(Surachai Chaisana)
Service Engineer

Date 15/06/2021

COPY

Meter Gamma vs Flowrate



COPY

The graph, titled "Meter Pressure vs Flowrate", plots DGM Orifice ΔH (mm H₂O) on the y-axis against Flowrate Standardized & Corrected (m³/min) on the x-axis. The y-axis ranges from 0.0 to 140.0 with major grid lines every 20.0 units. The x-axis ranges from 0.000 to 0.040 with major grid lines every 0.010 units. A series of five data points are plotted, showing a linear relationship. The data points are labeled with their flowrate values: 13.00, 25.00, 50.00, 80.00, and 120.00. A horizontal orange line is drawn across the graph at approximately 75 mm H₂O.

Flowrate Standardized & Corrected (m ³ /min)	DGM Orifice ΔH (mm H ₂ O)
13.00	~15
25.00	~25
50.00	~50
80.00	~80
120.00	~120

บริษัท สิทธิพรแอสโซซิเอตส์ จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Console Model: MC-572-V

COPY

SITHIPORN ASSOCIATES CO. LTD.

Web site : www.sithiphom.com # E-mail: service-epd@sithiphom.com

Sampling System Equipment Information	
Console Model Number	MC-572-V
Console Serial Number	1007055
GSM Model Number	SK25EX
GSM Serial Number	0005459
Meter Box Model Number	JENCO 765
Meter Box Serial Number	JC02484

Calibration Conditions		
Date	Time	8:30 AM
Calibration Reference No.	GC64APE0037	
Barometric Pressure	756	
Reference Thermometer	FLUKE 714	
Serial Number	9038005	

Console Thermocouple Simulator

Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-17	25	38	94	150	262	372	485	596	819	1043
Probe	-17	25	38	94	150						
Filter	-17	25	38	94	150						
Aux	-17	25	38	94	150						
Exit	-17	25	38								

	+ 1.50% Absolute
Stack	+
Probe	+
Filter	+

Tolerance Range

Meter
Exit

3.0 °C	2.0 °C
+ +	+ +

AMERICAN ASSOCIATION
OF UNIVERSITY AND COLLEGE
TEACHERS

Signature _____

Surachai Chaisana)
Service Engineer

UCC

บริษัท สิกิฟรอส แอสโซซิเอส จำกัด

Sithiporn Associates Co., Ltd.

451-451/1 ถนนปิ่นสัก กรุงเทพมหานคร 10700 โทร. 0-2433-8331, 0-2435-8800, 0-2434-9101 แฟกซ์ : 0-2433-1079, 0-2434-9510
451-451/1 Sirinthorn Road, Bangbunru, Bangkok 10700 Thailand Tel. (662) 433-8331, 435-8800, 434-9191 Fax: (662) 433-1079, 434-9510

DRY GAS METER XC-572-V

Serial No. : A2007510

METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961

5-POINT METRIC UNIT

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	A2007510
DGM Model Number	SK25EX
DGM Serial Number	00005115

Calibration Conditions			
Date	Time	11-Aug-21	1:00 PM
Calibration Reference No.	GC64APE0040		
Barometric Pressure	761	mm Hg	
Calibration Meter Gamma	0.9980	unitless	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	

Run Time		Calibration Data							
Elapsed (@) min	DGM Orifice ΔH (P _{or}) mm H ₂ O	Metering Console				Calibration Meter			
		Volume Initial (V _{or}) m ³	Volume Final (V _{or}) m ³	Outlet Temp Initial (T _{or}) °C	Outlet Temp Final (T _{or}) °C	Volume Initial (V _{cal}) m ³	Volume Final (V _{cal}) m ³	Outlet Temp Initial (T _{cal}) °C	Outlet Temp Final (T _{cal}) °C
15.00	13.0	192.9377	193.1065	25	25	217.64994	217.82028	25	25
10.00	25.0	193.1438	193.3008	25	25	217.85800	218.01650	25	25
8.00	50.0	193.3330	193.5109	25	25	218.04911	218.22929	25	25
7.00	80.0	193.5431	193.7402	25	25	218.26189	218.46254	25	25
5.00	120.0	193.7826	193.9548	25	25	218.50573	218.68184	25	25

Standardized Data				Results				
Dry Gas Meter		Calibration Meter		Calibration Factor		Dry Gas Meter		
(V _{avg}) m ³	(Q _{avg}) m ³ /min	(V _{cal}) m ³	(Q _{cal}) m ³ /min	Value (Y)	Variation (ΔY)	Std & Corr (Q _{std}) m ³ /min	Flowrate (ΔH@) mm H ₂ O	Variation (ΔΔH@)
0.166	0.011	0.167	0.011	1.006	-0.001	0.011	46.495	0.632
0.155	0.015	0.156	0.016	1.005	-0.002	0.016	46.005	0.141
0.176	0.022	0.177	0.022	1.006	-0.001	0.022	45.788	-0.076
0.195	0.028	0.197	0.028	1.008	0.001	0.028	45.491	-0.373
0.171	0.034	0.173	0.035	1.009	0.002	0.035	45.540	-0.324
				1.007	Y Average		45.864	ΔH@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02

Note: For ΔH_{or} , orifice pressure differential that equates to 0.75cfm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm)

Signature

(Sirichok Sansomsun)

SITHIPORN ASSOCIATES COMPANY

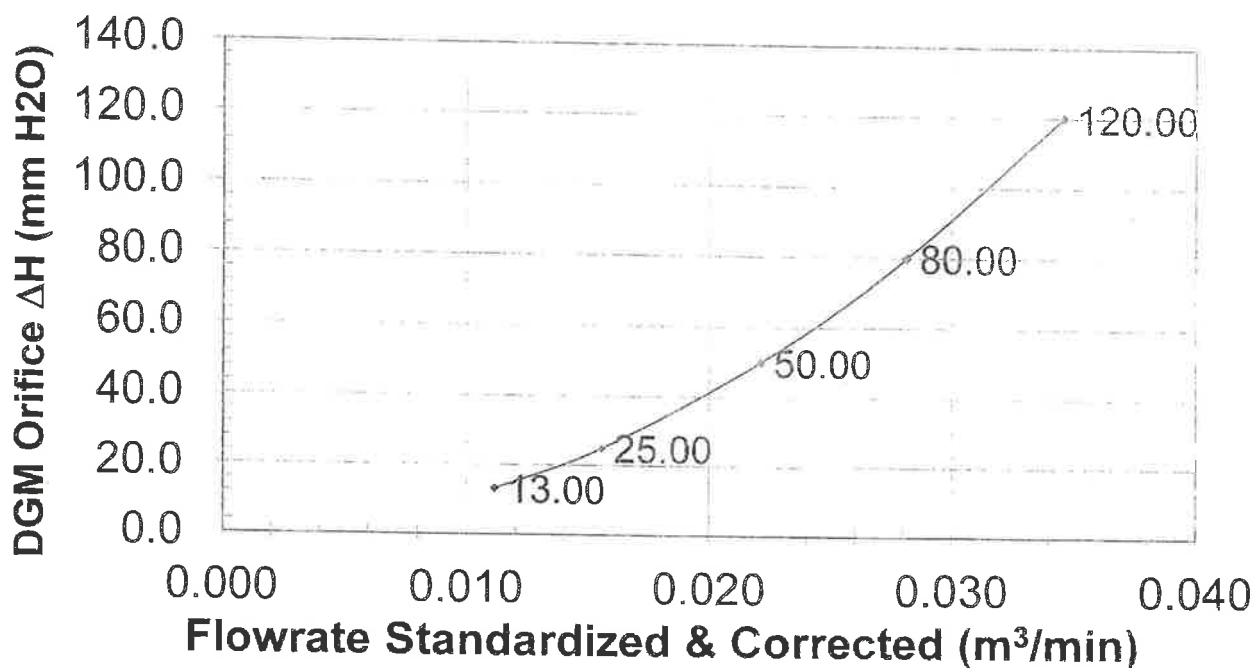
Date

11 / 8 / 2021

Calibration Date: 25-2-2014

Calibration Reference No: VO57AP0011

Meter Pressure vs Flowrate



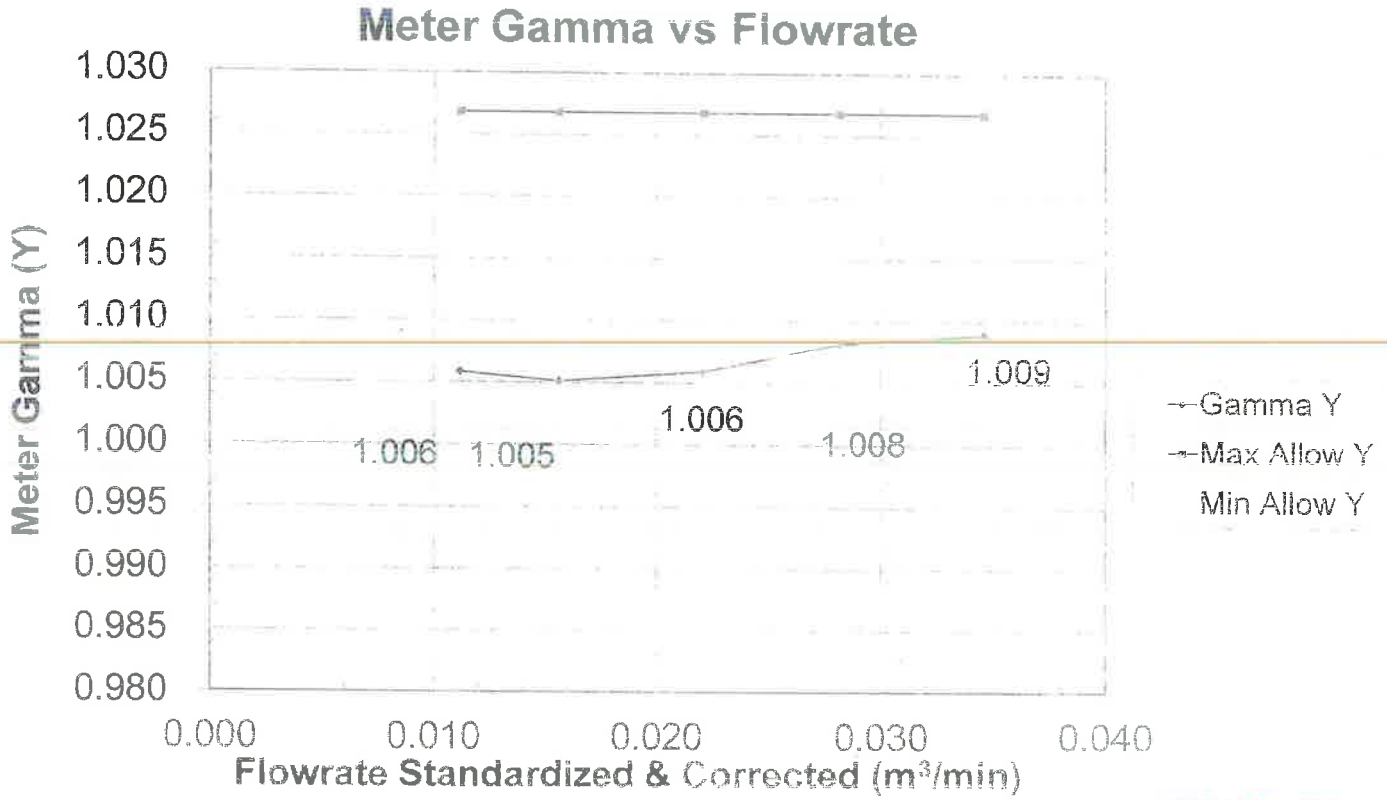
Console Serial:

A2007510

บริษัท สิทธีพรแอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Console Model:

XC-572-V



Console Serial:

A2007510

บริษัท สิริพิพร แอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY, LTD.

Console Model:

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SITHIPORN

THERMOCOUPLES SYSTEM CALIBRATION

SA Environmental Hygiene Products Division (EPD)
 Web site: www.sithiporn.com E-mail: sithiporn@signteam.com

Sampling System Equipment Information		Calibration Conditions	
Console Model Number	XC-572-V	Date	11-Aug-21
Console Serial Number	A2007510	Calibration Reference No.	GC64APE0040
DGM Model Number	SK25EX	Barometric Pressure	731 mm Hg
DGM Serial Number	00005115	Reference Thermometer	FLUKE 714
Meter Box Model Number	JENCO 765	Serial Number	9033005
Meter Box Serial Number	JC02982		

Results	
Console Thermocouple Simulator	
Channel and test point	Meter Box Channel Temperature Reading (°C)
Stack	-18.0 25.0 38.0 93.0 149.0 260.0 371.0 482.0 593.0 816.0 1033.0
Probe	-18 25 38 94 150 261 370 481 593 815 1037
Filter	-17 25 37 93 147
Aux	-17 25 37 93 148
Exit	-17 25 37 93 150

Tolerance Range	
Stack	+ 1.50% Absolute
Probe	+ 3.0 °C
Filter	+ 3.0 °C
Meter Exit	+ 3.0 °C
	± 2.0 °C

Note: Temperature difference ≤ 1.5%

Signature _____
 (Sirichok Sansomsup)
 Service Engineer

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SITHIPORN ASSOCIATES COMPANY, LTD.

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DRY GAS METER MC-572

Serial No. : 0011024

METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961
5-POINT METRIC UNIT

SIRICHOK SANSUPS
 Environmental Hygiene Products Division (EPD)
 Web site : www.sirichok.com & E-mail: service-epd@sirichok.com

Meter Console Information	
Console Model Number	MC-572
Console Serial Number	0011024
DGM Model Number	SK25EX
DGM Serial Number	00005437

Calibration Conditions			
Date	Time	07-Jan-22	1:00 PM
Calibration Reference No.	HC65APE0005		
Barometric Pressure	759	mm Hg	
Calibration Meter Gamma	0.9980	unitless	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	

Calibration Data									
Run Time	Metering Console					Calibration Meter			
Elapsed (t)	DGM Orifice (P _o)	Volume Initial (V _o)	Volume Final (V _o)	Outlet Temp Initial (t _o)	Outlet Temp Final (t _o)	Volume Initial (V _o)	Volume Final (V _o)	Outlet Temp Initial (t _o)	Outlet Temp Final (t _o)
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
15.00	13.0	519.3522	519.5372	25	25	248.31965	248.50831	25	25
10.00	25.0	519.5505	519.7196	25	25	248.52318	248.69613	25	25
8.00	50.0	519.7505	519.9399	25	25	248.72918	248.92339	25	25
7.00	80.0	519.9562	520.1641	25	25	248.94255	249.15608	25	25
5.00	120.0	520.1817	520.3645	25	25	249.17802	249.36602	25	25

Standardized Data				Results				
Dry Gas Meter		Calibration Meter		Calibration Factor		Dry Gas Meter		
(V _{std})	(Q _{std})	(V _{cal})	(Q _{cal})	Value (Y)	Variation (ΔY)	Flowrate Std & Corr (Q _{std})	ΔH @ .0212 m ³ /min	Variation (ΔΔH@)
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O	
0.182	0.012	0.185	0.012	1.016	-0.001	0.012	38.004	-1.317
0.166	0.017	0.169	0.017	1.018	0.001	0.017	38.741	-0.560
0.187	0.023	0.190	0.024	1.018	0.001	0.024	39.516	0.195
0.206	0.029	0.209	0.030	1.017	0.000	0.030	40.276	0.955
0.181	0.036	0.184	0.037	1.015	-0.002	0.037	40.070	0.748
				1.017	Y Average		39.321	ΔH@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .

Note: For ΔH_{std}, orifice pressure differential that equates to 0.75cfm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

Signature Sirichok Sansomsup
 (Sirichok Sansomsup)
 Service Engineer

วันที่ ๗/๐๑/๒๕๖๕
 บริษัท สิริโชค แซงซอมป์ จำกัด

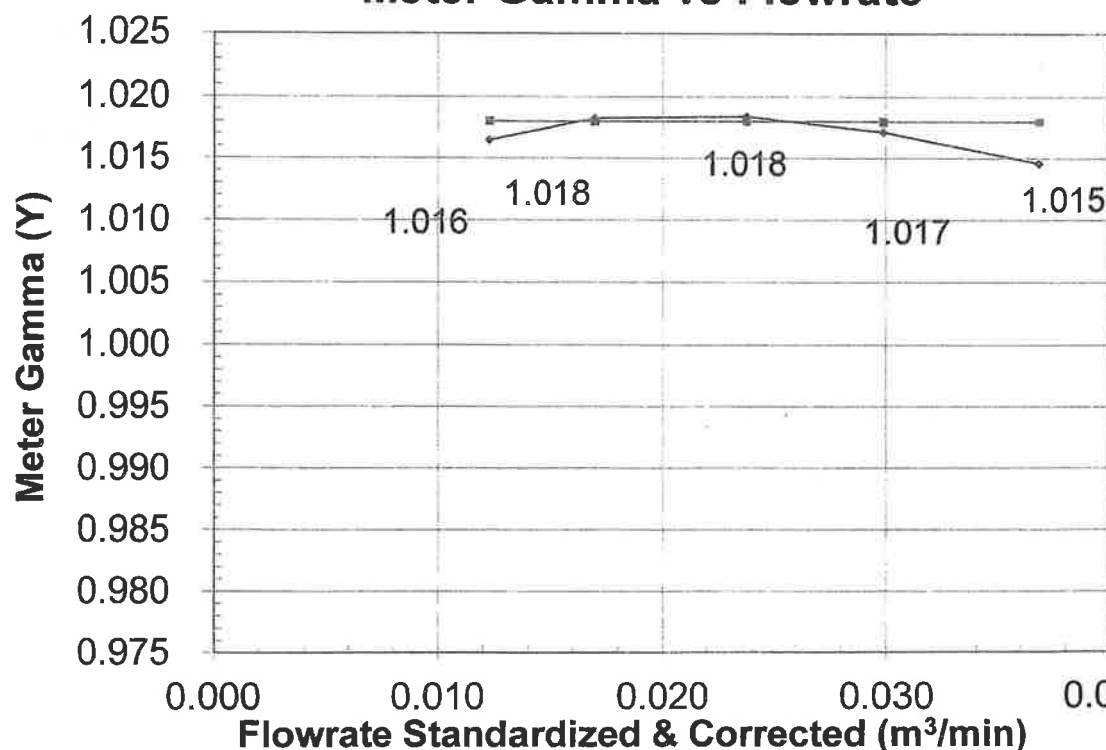
Date 07/01/2022

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Calibration Date: 25-2-2014

Calibration Reference No: VO57AP0011

Meter Gamma vs Flowrate



Console Serial: 0011024

วันที่ ๗/๐๑/๒๕๖๕
 บริษัท สิริโชค แซงซอมป์ จำกัด

Console Model: MC-572

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THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	MC-572
Console Serial Number	0011024
DGM Model Number	SK25EX
DGM Serial Number	00005437
Meter Box Model Number	JENCO 765
Meter Box Serial Number	JC02982

Calibration Conditions	
Date	07-Jan-22
Calibration Reference No.	HC65APE0005
Barometric Pressure	759
Reference Thermometer	FLUKE 714
Serial Number	90380005

Results	
Console Thermocouple Simulator	
Meter Box Channel Temperature Reading (°C)	
Channel and test point	
Stack	-18.0 25.0 38.0 93.0 149.0 260.0 371.0 482.0 593.0 816.0 1038.0
Probe	-18 25 38 94 150 261 372 483 595 817 1040
Filter	-18 25 38 94 150
Aux	-18 25 38 94 150
Exit	-18 25 38

Tolerance Range	
Stack	± 1.50% Absolute
Probe	± 3.0 °C
Filter	± 3.0 °C
Meter Exit	± 3.0 °C

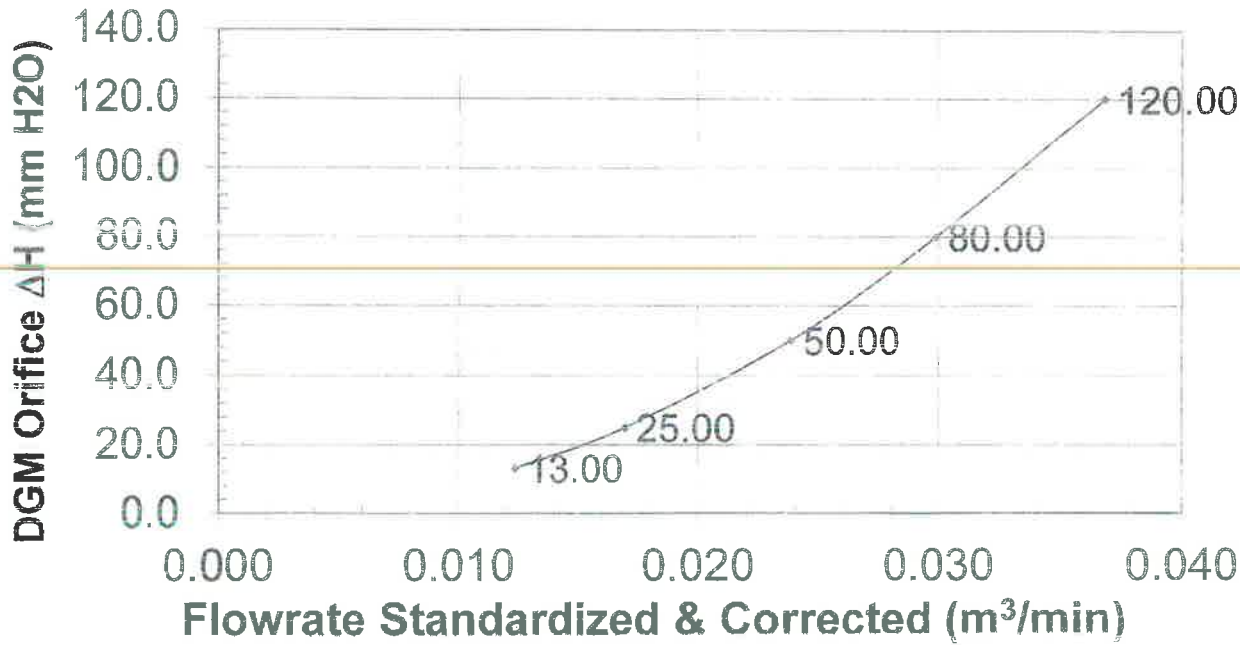
Note: Temperature difference ≤ 1.5%

Signature

(Sirichok Sansomsup)
Service Engineer

บริษัท สิทธีพร แอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Meter Pressure vs Flowrate



Console Serial:

0011024

บริษัท สิทธีพร แอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Console Model:

MC-572

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COPY

บริษัท สิทธีพร แอสโซซิเอต จำกัด

Sithiporn Associates Co., Ltd.

451-451/1 ถนนสุขุมวิท แขวงบางนา เขตคลองเตย กรุงเทพมหานคร 10700 โทร. 0-2433-8331, 0-2435-8800, 0-2434-9191 แฟกซ์ : 0-2433-1679, 0-2434-9510

451-451/1 Srinthorn Road, Bangumru, Bangkok 10700 Thailand Tel. (662) 433-8331, 435-8800, 434-9191 Fax: (662) 433-1679, 434-9510

Flue gas Analyzer

Testo 350XL

Serial No. 01859560



Certificate No: G 640712
Date of issue : 29-Oct-21

Instrument description : Flue gas Analyzer
Instrument model : Testo 350XL
Instrument serial no. : 01859560
ID no. or control no. : -
Manufacturer : testo SE
Probe description : -
Probe model : -
Probe serial : -
Customer name : Eastern Thai Consulting 1992 Company Limited
Customer address : 683 Moo 11, Sukhapibarn 8 Road, Nongkham, Si Racha, Chon Buri 20280

Total pages of certificate : 2 Pages
Receiving no. : L-213012
Receiving date. : 28-Oct-21
Parameter of calibration : Gas Calibration(Oxygen 2.501,10.00,21.00 %vol, Carbon Monoxide 80.97,309.9,1003 ppm Nitrogen Dioxide 80.62 ppm, Sulphur Dioxide 100.9 ppm, Nitric Oxide 150.9 ppm)

Condition of UUC. : Used

Ambient condition : All of the Measurement were carried out the stabilized laboratory

Temperature : 23 ± 5 °C

Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210

Calibration procedure no. : WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurment Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid.

This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 29-Oct-21

Kwanchai K.

Mr. Kwanchai Khamdoun
Calibration Technician

D. Nongluck

Mrs. Nongluck Wongsettee
Technical Manager

COPY



Certificate No.: G 640712

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.501 % Vol	2431/19	Linde	16-Jul-23
Oxygen (O ₂) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen (O ₂) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide (CO) 80.97 ppm	2842/21	Linde	24-Jun-23
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2829/21	Linde	23-Apr-23
Nitrogen Dioxide (NO ₂) 80.62 ppm	3240/21	Linde	25-Jul-23
Sulphur Dioxide (SO ₂) 100.9 ppm	4942/20	Linde	20-Nov-22
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23

Measured room conditions

Temperature : 23.6 °C Humidity : 57.8 %RH Pressure : 1014.1 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1023.6 mbar

Calibration Results (without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.501	2.45	-0.051	0.20
O ₂ (%Vol)	10.00	9.86	-0.14	0.40
O ₂ (%Vol)	21.00	21.14	0.14	0.80
CO (ppm)	80.97	82	1.03	2.8
CO (ppm)	309.9	314	4.1	11
CO (ppm)	1003	1017	14	34
*NO ₂ (ppm)	80.62	80.2	-0.42	5.0
*SO ₂ (ppm)	100.9	102	1.1	5.0
*NO (ppm)	150.9	149	-1.9	5.0

Remark : 1 cmol/mol = 1 %vol. , 1 µmol/mol = 1 ppm.

* Calibrations marked Not TISI Accredited "in this Certificate have been included for completeness."

End of Report

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GAS CHROMATOGRAPH

MODEL : GC-2010 Plus AF

S/N : C12095200986

3. Operational Qualification Record

If the unit is included in the system to be inspected, place a checkmark in the "Applicable" box. If the unit is not included in the system, place a checkmark in the "Not Applicable" box. Enter a diagonal line in the Pass/Fail checkbox for "Not applicable" items.

Here, Inspection results are recorded along the procedure of Chapter 4 in Operational Qualification Protocol.

3-1 Gas Chromatograph GC-2010Plus

☒ Applicable ☐ Not Applicable

Component ID		Model Name		GC-2010Plus AF	
Serial Number (S/N)		C 1 2 0 9 5 2 0 0 9 8 6			
No.	Item	Criteria	Results	Pass	Fail
1	Display, LED test	Verify the display and LED operation.	All LEDs light. LED Screen contrast adjustment is possible. Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Standard self-diagnostic test	Verify the status and operation of all parts.	"Good" displayed as the result of the self-diagnostic test. Good	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Firmware version check	Verify the program version.	Version number and build number are displayed. The version No. and build No. matches the controlled version number. Ver. Version: 2.1040 Build No.: 262 Controlled Ver. No. Version: 2.1046 Build No.: 262	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Temperature test	Verify that temperature control is normal.	TEMP LED lights green. Displayed actual values agree to the set values within $\pm 1.0^{\circ}\text{C}$.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		Temperature controller	(Name) Set value Measured value		
		<input checked="" type="checkbox"/> COL	COL 50.0°C 50.0°C		
		<input checked="" type="checkbox"/> INJ1	50.0°C 50.0°C		
		<input type="checkbox"/> INJ2	°C °C		
		<input checked="" type="checkbox"/> DET1	20.0°C 50.0°C		
		<input type="checkbox"/> DET2	°C °C		
		<input type="checkbox"/> AUX3	°C °C		
		<input type="checkbox"/> AUX4	°C °C		
		<input type="checkbox"/> AUX5	°C °C		
5	Column inlet pressure test	Verify the accuracy of the column inlet pressure.	Inspection pressure gauge reading $10.0 \pm 3.0\text{kPa}$ Pressure gauge correction value 0.0 kPa Pressure gauge reading 4.9 kPa Post-correction reading 9.9 kPa Inspection pressure gauge reading $200.0 \pm 20.0\text{kPa}$ Pressure gauge correction value 0.5 kPa Pressure gauge reading 197.2 kPa Post-correction reading 197.7 kPa Inspection pressure gauge reading $300.0 \pm 35.0\text{kPa}$ Pressure gauge correction value 1.0 kPa Pressure gauge reading 299.2 kPa Post-correction reading 298.2 kPa	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Performer (signature):

Date: 25 / 08 / 2021

Reviewer (signature):

Date: / /

No.	Item	Criteria	Results	Pass	Fail
6	Pressure program test	Verify that the pressure program operates normally.	Monitored pressure 6 minutes after start $250.0 \pm 5.0\text{kPa}$ Inspection pressure gauge reading 8 minutes after start $250.0 \pm 20.0\text{kPa}$	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	Flowrate test	Verify the accuracy of the full-flow and septum purging.	Septum purge vent measured flow rate $3.0 \pm 1.0\text{mL/min}$ Split vent 2.5 mL/min Total 10.0 mL/min Total of septum purge and split vent flow rate values $10.0 \pm 3.0\text{mL/min}$ Split vent 20.2 mL/min Total 20.5 mL/min Total of septum purge and split vent flow rate values $200 \pm 20\text{mL/min}$ Split vent 30.7 mL/min Total 510 mL/min Total of septum purge and split vent flow rate values $300 \pm 28\text{mL/min}$ (Carrier gas: N_2) Total of septum purge and split vent flow rate values $500 \pm 35\text{mL/min}$ (Carrier gas: He)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8	Column oven test	Verify the accuracy of the column oven temperature.	Inspection temperature sensor displayed value $150.0 \pm 3.2^{\circ}\text{C}$ Temp. correction value -0.3°C Temp. sensor reading 51.0°C Corrected temp. value 50.7°C Inspection temperature sensor displayed value $150.0 \pm 4.2^{\circ}\text{C}$ Temp. correction value -0.3°C Temp. sensor reading 151.8°C Corrected temp. value 151.2°C Inspection temperature sensor displayed value $280.0 \pm 5.5^{\circ}\text{C}$ Temp. correction value -0.4°C Temp. sensor reading 281.2°C Corrected temp. value 280.8°C	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9	Temperature program test	Verify that the column temperature program operates normally.	Monitored temperature 6 minutes after start $200 \pm 1^{\circ}\text{C}$ Inspection temperature reading 8 minutes after start $200.0 \pm 4.7^{\circ}\text{C}$ Using a temperature sensor with 1°C minimum display increment $200 \pm 3^{\circ}\text{C}$	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10	Sensitivity test	Verify the detector sensitivity.	FID (<input checked="" type="checkbox"/> Applicable) <input type="checkbox"/> Not Applicable) Calculated S value Inj. unit (50.1) Make-up gas: N_2 $10.0 \times 10^{-3}\text{C/g min.}$ Make-up gas: He $7.00 \times 10^{-3}\text{C/g min.}$ C16AREA value 51372 Calculated S value $1.640 \times 10^{-3}\text{C/g}$ TC1 (<input type="checkbox"/> Applicable) <input checked="" type="checkbox"/> Not Applicable) Calculated S value Inj. unit (4.00) $4.00 \times 10^{-3}\text{mV}\cdot\text{mL/mg min.}$ C10AREA value μV·s Flowrate at vent mL/min Calculated S value $\times 10^3\text{mV}\cdot\text{mL/mg}$	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Performer (signature):

Date: 25 / 08 / 2021

Reviewer (signature):

Date: / /

Operational Qualification

Operational Qualification Record

3-2 AOC-20i Auto Injector

☒ Applicable ☐ Not Applicable☒ Single ☐ Dual system, main injector

Model Name		AOC-20i				
Component ID						
Serial No. (S/N)		C 1 2 1 2 5 4 1 0 3 0 9				
No.	Item	Criteria	Results	Pass	Fail	
1	Display, LED test	Verify the display and LED operation.	All LEDs light, except decimal point.		<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	ROM, RAM self diagnosis	Verify that ROM and RAM memory operates normally.	Display shows "000".	Display: 000	<input type="checkbox"/>	<input type="checkbox"/>
3	Firmware version check	Verify the program version.	Version number is displayed.	Version No. 3.4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
			The version number matches the controlled version number.	Controlled Ver. No. 3.4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Basic operation test	Verify that the auto injector basic operation is correct.	Sample injected into the GC and GC operation starts.		<input type="checkbox"/>	<input type="checkbox"/>

☒ Not Applicable ☐ Dual system, sub injector

Model Name		AOC-20i				
Component ID						
Serial No. (S/N)						
No.	Item	Criteria	Results	Pass	Fail	
1	Display, LED test	Verify the display and LED operation.	All LEDs light, except decimal point.		<input type="checkbox"/>	<input type="checkbox"/>
2	ROM, RAM self diagnosis	Verify that ROM and RAM memory operates normally.	Display shows "000".	Display:	<input type="checkbox"/>	<input type="checkbox"/>
3	Firmware version check	Verify the program version.	Version number is displayed.	Version No.	<input type="checkbox"/>	<input type="checkbox"/>
			The version number matches the controlled version number.	Controlled Ver. No.	<input type="checkbox"/>	<input type="checkbox"/>
4	Basic operation test	Verify that the auto injector basic operation is correct.	Sample No.1 transferred to the main injector, sample No. 2 transferred to the sub-injector. Sub-injector injects into the GC simultaneously with the main AOC.		<input type="checkbox"/>	<input type="checkbox"/>

Performer (signature):

Ch

Date: 25 / 08 / 2021

Reviewer (signature):

Date: / /

Operational Qualification

Operational Qualification Record

3-3 AOC-20s Auto Sampler

☒ Applicable ☐ Not Applicable

Model Name		AOC-20s				
Component ID						
Serial No. (S/N)		C 1 2 1 9 5 4 0 5 9 1 0				
No.	Item	Criteria	Results	Pass	Fail	
1	Initial operation test	Verify that the auto sampler basic operation is correct.	LED lights green, not red.		<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Firmware version check	Verify the program version.	Version number is displayed.	Version No. 3.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>
			The version number matches the controlled version number.	Controlled Ver. No. 3.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Performer (signature):

Ch

Date: 25 / 08 / 2021

Reviewer (signature):

Date: / /

Hot Air Oven

Model : UM 400

Serial No. : 900982



ASIA MEDICAL AND AGRICULTURAL LABORATORY
AND RESEARCH CENTER CO., LTD.

361,361/1-4 Soi Ladprao 122, (Mahadthai 1), Ladprao Road, Phlabphla,
Wangthonglang, Bangkok, Thailand 10310, Head Office
Tel.(66) 2-934-2381-3 Fax(66) 2-934-0661
http://www.amarc.co.th Email: d@amarc.co.th



NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-049716
Sample code : 21-19686-006

Page 1 of 3

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.

683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of calibration : EASTERN THAI CONSULTING 1992 CO., LTD.
(Hot Lab)

Equipment : Temperature controlled enclosures (Hot air oven)

Manufacturer : Memmert Model : UM 400

Serial No. : 900982 ID No. : LABE 17/1

Date of receipt : 09 June 2021 Date of calibration : 09 June 2021

Condition of calibration

1 Environment Ambient temperature : Maximum 32.7 °C ; Minimum 30.1 °C
Relative humidity : Maximum 60.3 % ; Minimum 44.1 %
Line voltage supplied : Maximum 228.5 VAC ; Minimum 221.3 VAC

2 Calibration method TLAS-G-20 : Guidelines for calibration and checks of temperature controlled enclosures

3 Reference standard instrument

Instrument	ID.No.	Certificate No.	Due date
Data Acquisition With Sensor (RTD-Pt100)	LB-DA-12 (RTD-178 to RTD-186)	21-038924	06 May 2022

4 This certificate is traceable to the international system of unit (SI Unit)

The measurement is traceable to Thailand Institute of Scientific and Technological Research through Asia Medical and
Agricultural Laboratory and Research Center Co., Ltd.

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

6 Condition of calibration item : Normal

Calibrated by Mr. Sarawoot Thammo

Scientist

Approved by

(Mr. Somchai Neampunt)

Signed for Director

Date of issue : 14 June 2021

The uncertainties are for a confidence probability of approximately 95%

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the
measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding
national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and
Agricultural Laboratory and Research Center Co., Ltd. (AMARC)



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AND RESEARCH CENTER CO., LTD.

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http://www.amarc.co.th Email: d@amarc.co.th



NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-049716
Sample code : 21-19686-006

Page 2 of 3

REPORT OF CALIBRATION

Results of calibration

Resolution : 0.1 °C

1. Reporting of temperature

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Measured temperature at Each Positions (°C)										Uncertainty ± (°C)	Coverage factor k
			#1	#2	#3	#4	#5	#6	#7	#8	#9 ^{Ref}	#10		
85	85.0	85.0	84.98	84.92	84.61	84.66	84.93	84.88	84.93	84.82	84.92	84.92	0.27	2.00

2. Characterization result

Calibration point (°C)	Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
85	0.16	0.32	0.67

Note

UUC* = Unit Under Calibration

[Signature]

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AND RESEARCH CENTER CO., LTD.

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http://www.amarc.co.th Email: cl@amarc.co.th



NSC-TIS-TIS 17025
CALIBRATION 0152

Certificate No. : 21-049716
Sample code : 21-19686-006

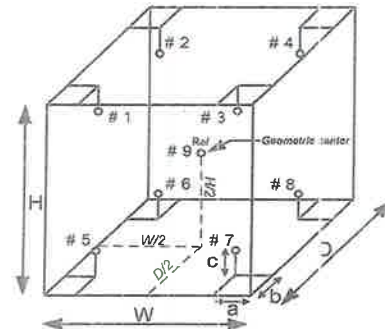
Page 3 of 3

REPORT OF CALIBRATION

Results of calibration

Note

- Sensor installation locations
 - All sensors at any corners or walls should be positioned 5 cm (a x b x c) from the wall.
 - The reference sensor is preferably located of the geometric center of the chamber.
- Interior dimensions approx of chamber ;
W = 40 cm ; D = 28 cm ; H = 39 cm
- Air valve or fresh air level ; Off
- Fan level ; Open
- The quoted uncertainty include " Stability of chamber and loading effect in chamber at 20% of uniformity ".
- Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.
- Temperature stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.
- Overall variation - the difference of the maximum and the minimum measured temperatures throughout observation time.
- UUC* Reading - the average reading of indicating device that forms the integral part of the enclosure.
- Calibration results without adjustment.



sensor installation Positions

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003

[Signature]

End of report

COPY

Hot Air Oven

Model : UM 400

Serial No. : 900982

CERTIFICATE OF CALIBRATION

Page 1 of 3

Certificate No. : 22-025399

Sample Code : 22-09604-002

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of Calibration : EASTERN THAI CONSULTING 1992 CO., LTD.
(Hot Lab)

Equipment : Temperature controlled enclosures (Hot air oven)

Manufacturer : Memmert Model : UM 400

Serial No. : 900982 ID No. : LABE 17/1

Date of Receipt : 11 March 2022 Date of Calibration : 11 March 2022

Condition of Calibration

1. Environment
- | | | | | |
|---------------------------|-----------|-----------|-----------|-----------|
| 1.1 Ambient temperature | : Maximum | 28.7 °C | ; Minimum | 27.4 °C |
| 1.2 Relative humidity | : Maximum | 61.5 % | ; Minimum | 55.8 % |
| 1.3 Line voltage supplied | : Maximum | 226.5 VAC | ; Minimum | 224.7 VAC |

2. Calibration method

TLAS-G-20: Guidelines for calibration and checks of temperature controlled enclosures.

3. Reference standard instrument

Instrument	ID No.	Certificate No.	Due Date
Data Acquisition With Sensor (RTD-P1100)	LB-DA-11 (RTD-138 to RTD-146)	21-035792	18 May 2022

4. This certificate is traceable to the international system of unit (SI Unit).

The measurement is traceable to Asia Medical and Agricultural Laboratory and Research Center Public Company Limited.

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

6. Condition of calibration item : Normal

Calibrated by Mr. Natthan Phosri
Scientist

Approved by

(Mr. Somchai Neampunt)

Signed for Director

Issue date 14 March 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).

REPORT OF CALIBRATION

Page 2 of 3

Certificate No. : 22-025399

Sample Code : 22-09604-002

Results of Calibration

Resolution : 0.1 °C

1. Reporting of Temperature

Calibration point (°C)	UUC* setting (°C)	UUC* reading (°C)	Measured temperature at each positions (°C)									Uncertainty ± (°C)	Coverage factor <i>k</i>
			#1	#2	#3	#4	#5	#6	#7	#8	#9 ^{Ref}		
85	85.0	85.0	85.05	84.99	84.66	84.71	84.85	84.92	84.96	84.86	84.98	0.25	2.00

2. Characterization results

Calibration point (°C)	Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
85	0.08	0.35	0.54

Notes

- UUC* = Unit Under Calibration

Calibrated by Mr. Natthan Phosri
Scientist

Approved by

(Mr. Somchai Neampunt)

Signed for Director

Issue date 14 March 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).

REPORT OF CALIBRATION

Certificate No. : 22-025399

Sample Code : 22-09604-002

Results of Calibration

Notes

- Sensor installation locations
 - All sensors at any corners or walls should be positioned 5 cm (a x b x c) from the wall.
 - The reference sensor is preferably located of the geometric center of the chamber.
- Interior dimensions approx of chamber :
 $W = 40 \text{ cm}$; $D = 28 \text{ cm}$; $H = 39 \text{ cm}$
- Air valve or fresh air level : Off
- Fan level : Open
- The quoted uncertainty includes" Stability of chamber and loading effect in chamber at 20% of uniformity ".
- Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.
- Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.
- Overall variation - the difference of the maximum and the minimum measured temperatures throughout observation time.
- UUC* reading - the average reading of indicating device that forms the integral part of the enclosure.
- Calibration results without adjustment.

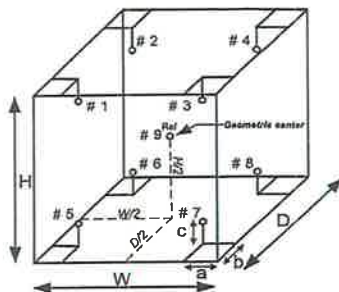


Figure: Example of sensor installation Positions

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003.

- End of Report -

COPY

Hot Air Oven

Model : UFE 500

Serial No. : G511.0182

CERTIFICATE OF CALIBRATION

Certificate No. : 22-011766

Sample Code : 22-04498-003

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.

683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of Calibration : EASTERN THAI CONSULTING 1992 CO., LTD.

(Laboratory)

Equipment : Temperature controlled enclosures (Hot air oven)

Manufacturer : Memmert Model : UFE 500

Serial No. : G511.0182 ID No. : LABE 17/4

Date of Receipt : 03 February 2022 Date of Calibration : 03 February 2022

Condition of Calibration

1. Environment
- | | | | | | | |
|---------------------------|---|---------|-----------|---|---------|-----------|
| 1.1 Ambient temperature | ± | Maximum | 27.5 °C | ± | Minimum | 26.4 °C |
| 1.2 Relative humidity | ± | Maximum | 59.5 % | ± | Minimum | 50.8 % |
| 1.3 Line voltage supplied | ± | Maximum | 225.1 VAC | ± | Minimum | 223.2 VAC |

2. Calibration method

TLAS-G-20: Guidelines for calibration and checks of temperature controlled enclosures.

3. Reference standard instrument

Instrument	ID No.	Certificate No.	Due Date
Data Acquisition With Sensor (RTD-P100)	LB-DA-11 (RTD-148 to RTD-155, RTD-227)	21-041213	09 May 2022

4. This certificate is traceable to the international system of unit (SI Unit).

The measurement is traceable to Asia Medical and Agricultural Laboratory and Research Center Public Company Limited.

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

6. Condition of calibration item : Normal

Calibrated by Mr. Pattarakorn Panklong

Scientist

Approved by

(Mr. Somchai Neampunt)

Signed for Director

Issue date 11 February 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).

REPORT OF CALIBRATION

Certificate No. : 22-011766

Sample Code : 22-04498-003

Results of Calibration

Resolution : 0.5 °C

1. Reporting of Temperature

Calibration point (°C)	UUC* setting (°C)	UUC* reading (°C)	Measured temperature at each positions (°C)									Uncertainty ± (°C)	Coverage factor k
			# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9 ^{Ref}		
104	103.5	103.5	104.46	104.45	#####	104.07	104.46	104.42	104.34	104.07	104.30	0.53	2.00

2. Characterization results

Calibration point (°C)	Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
104	0.12	0.80	1.13

Notes

- UUC* = Unit Under Calibration

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REPORT OF CALIBRATION

Certificate No. : 22-011766

Sample Code : 22-04498-003

Results of Calibration

Notes

1. Sensor installation locations

1.1 All sensors at any corners or walls should be positioned
5 cm (a x b x c) from the wall.

1.2 The reference sensor is preferably located of the geometric center
of the chamber.

2. Interior dimensions approx of chamber :

W = 56 cm ; D = 40 cm ; H = 48 cm

3. Air valve or fresh air level : Off

4. Fan level : Open

5. The quoted uncertainty includes "Stability of chamber and loading effect
in chamber at 20% of uniformity".6. Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference
location which are observed at the same time.

7. Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

8. Overall variation - the difference of the maximum and the minimum measured temperatures throughout observation time.

9. UUC* reading - the average reading of indicating device that forms the integral part of the enclosure.

10. Calibration results without adjustment.

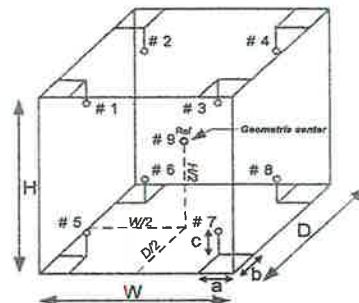


Figure: Example of sensor
installation Positions

The result expanded uncertainty of measurement U 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%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003.

- End of Report -

COPY

LIQUID IN GLASS THERMOMETER

Model : Total Immersion

Serial No. : 43560



QUALITY CALIBRATION CO.,LTD.
235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com



CERTIFICATE No : 21T10802
REFERENCE No : 62916-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : LIQUID IN GLASS THERMOMETER
MANUFACTURER : PRECISION
MODEL : 0 °C TO 100 °C
SERIAL No : 43560
ID No : LABE 16/1
RESOLUTION : 0.1 °C
TYPE : TOTAL IMMERSION
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : EASTERN THAI CONSULTING 1992 COMPANY LIMITED
999 MOO.11 NONGKHAM, SRIRACHA, CHONBURI
20230

CALIBRATED BY : CHARUKIT L.
CALIBRATION DATE : 27-Oct-21
APPROVED BY : PONGSAK J.
ISSUED DATE : 27-Oct-21
RECEIVED DATE : 21-Oct-21

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THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



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235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com

CERTIFICATE No : 21T10802

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : LIQUID IN GLASS THERMOMETER
MANUFACTURER : PRECISION
MODEL : 0 °C TO 100 °C
ID No : LABE 16/1
RESOLUTION : 0.1 °C
RECEIVED DATE : 21-Oct-21
AMBIENT TEMPERATURE : 23 °C ± 3 °C
SERIAL NUMBER : 43560
TYPE : TOTAL IMMERSION
CALIBRATION DATE : 27-Oct-21
RELATIVE HUMIDITY : 50 %RH ± 20 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BASED ON ASTM E77:1992 BY COMPARISON WITH STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT) INTO LIQUID BATH TEMPERATURE CONTROLLER. THE TEMPERATURE SCALE USED WAS BASED ON ITS-90.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD THERMOMETER	1502	77964	21T3033	08-Mar-22
2) SPRT PROBE	5614	636626	21T3033	08-Mar-22
3) PRECISION BATH	7320	A21105	20T12163	16-Dec-21
4) PRECISION BATH	CTR-40	A68155	20T12164	22-Dec-21

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

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

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND).

RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

STANDARD READING (°C)	UUC* READING (°C)	IMMERSION DEPTH (mm)	CORRECTION (°C)	EMERGENT STEM TEMPERATURE (°C)	UNCERTAINTY OF MEASUREMENT (±°C)
0.004	0.0	60	0.004	N/A	0.090
25.009	25.0	160	0.009	N/A	0.090
50.012	50.0	270	0.012	N/A	0.090

UUC* : UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

COPY

ORIFICE TRANSFER STANDARD CERTIFICATION

WORKSHEET TE-5025A

ROOTSMETER S/N 0438320



TISCH ENVIRONMENTAL, INC.
145 SOUTH MIAMI AVE
VILLAGE OF CLEVELAND, OH
45002
513.467.9000
877.263.7810 TOLL FREE
513.467.9009 FAX

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Mar 24, 2016 Rootsmeter S/N 0438320 Ta (K) - 295
Operator Tisch Orifice I.D. - 0136 Pa (mm) - 742.95

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.3400	3.2	2.00
2	NA	NA	1.00	0.9510	6.3	4.00
3	NA	NA	1.00	0.8510	7.8	5.00
4	NA	NA	1.00	0.8130	8.6	5.50
5	NA	NA	1.00	0.6690	12.6	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9832	0.7337	1.4054	0.9957	0.7430	0.8911
0.9791	1.0296	1.9875	0.9915	1.0426	1.2603
0.9770	1.1481	2.2221	0.9894	1.1626	1.4090
0.9760	1.2006	2.3305	0.9884	1.2157	1.4778
0.9707	1.4510	2.8107	0.9830	1.4694	1.7823
Qstd slope (m) = 1.96262			Qa slope (m) = 1.22856		
intercept (b) = -0.03249			intercept (b) = -0.02060		
coefficient (r) = 0.99993			coefficient (r) = 0.99993		

y axis = $\text{SQRT}[\text{H2O}(\text{Pa}/760)(298/\text{Ta})]$

y axis = $\text{SQRT}[\text{H2O}(\text{Ta}/\text{Pa})]$

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = $1/m\{[\text{SQRT}(\text{H2O}(\text{Pa}/760)(298/\text{Ta}))] - b\}$
Qa = $1/m\{[\text{SQRT}(\text{H2O}(\text{Ta}/\text{Pa}))] - b\}$

COPY

pH Meter

Model : SevenCompactTM pH/Ion Meter S220

Serial No. : B448305208

Certificate Number CCP-0443-21**Calibration Certificate**
SevenCompact™ pH/Ion Meter S220**Customer**Company EASTERN THAI CONSULTING 1992 CO., LTD.Address 683 Moo 11, Sukhaphiban 8 Rd.,Nong Kham, SrirachaChonburi 20230Customer ID number 301608441Customer representative K.Sasiporn NekinOrder Number 
4 2 5 2 1 1 2 6 2 5**Instrument**Type SevenCompact™ S220Instrument Serial Number B448305208Internal identification LABE 11/4Firmware version 1.20.06**Technical specifications**Measuring Range -1999.9 ... 1999.9 mV -2.000 ... 20.000 pHResolution 0.1 mV 0.001 pHLimit of Error ± 0.2 mV ± 0.002 pHTemperature range MTC -30.0 ... 130.0 °CTemperature range ATC -5.0 ... 130.0 °CResolution 0.1 °CLimit of Error ± 0.1 °C**Procedure Statement**

METTLER TOLEDO Certification SOP (Doc. No. 30027577) will be used as referring documentation to adjust and certify the instrument indicated in the "Type" and "Serial number" section. The measurement results of this certification were obtained at ambient conditions.

COPYCertificate Number CCP-0443-21**Certification Tools**Certified digital voltmeter Manufacturer GOSSEN METRAWATTSerial number ZD1740Certificate number E1U202338Control No. ANA77Due date July 14, 2021Certified Temperature Resistors Manufacturer METTLER TOLEDO / ME-5130241Serial number A116Certificate number S2542Control No. IN86Due date December 3, 2021**COPY**

Certificate Number **CCP-0443-21**

Certification Measurements

Designation	Certified value	Measured value	Max. Tolerance	Passed / Failed
-1900 mV	-1900.0 mV	-1899.9 mV	0.2 mV	Passed
-1000 mV	-1000.0 mV	-999.9 mV	0.2 mV	Passed
-500 mV	-500.0 mV	-500.0 mV	0.2 mV	Passed
-180 mV	-180.0 mV	-180.0 mV	0.2 mV	Passed
0 mV	0.0 mV	0.0 mV	0.2 mV	Passed
180 mV	180.0 mV	180.0 mV	0.2 mV	Passed
500 mV	500.0 mV	500.0 mV	0.2 mV	Passed
1000 mV	1000.0 mV	999.9 mV	0.2 mV	Passed
1900 mV	1900.0 mV	1899.9 mV	0.2 mV	Passed

Designation	Measured low imp.	Measured high imp.	Max. Tolerance	Passed / Failed
1900 mV	1899.9 mV	1899.8 mV	0.6 mV	Passed

Designation	Nominal value	Measured value	Max. Tolerance	Passed / Failed
NTC 30 kΩ, 0 °C	0.0 °C	0.0 °C	0.1 °C	Passed
NTC 30 kΩ, 25 °C	25.0 °C	25.0 °C	0.1 °C	Passed
NTC 30 kΩ, 50 °C	50.0 °C	49.9 °C	0.1 °C	Passed
NTC 30 kΩ, 75 °C	75.0 °C	75.0 °C	0.1 °C	Passed
NTC 30 kΩ, 100 °C	100.0 °C	100.0 °C	0.1 °C	Passed
Pt1000, 0 °C	0.0 °C	0.0 °C	0.1 °C	Passed
Pt1000, 25 °C	25.0 °C	25.0 °C	0.1 °C	Passed
Pt1000, 50 °C	50.0 °C	50.0 °C	0.1 °C	Passed
Pt1000, 75 °C	75.0 °C	75.0 °C	0.1 °C	Passed
Pt1000, 100 °C	100.0 °C	100.0 °C	0.1 °C	Passed

Summary of Certification

Certification of instrument

Passed

The instrument referred to in this certificate has fulfilled the criteria of the certification. This is indicated by the notation Passed in the column above.

Remarks

Certification of the instrument was performed by

Name Punchanakrit RujlpreparatFunction Service EngineerPlace LaboratoryCalibration Date: April 21, 2021Signature ELECTRONIC SIGNATURE

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Performance Test

Control No. CCE-0443-21/1

Company: **EASTERN THAI CONSULTING 1992 CO., LTD.**Address: **583 Moo 11, Sukhaphiban 8 Rd., Nong Kham, Sriracha**

Chonburi 20230

Order Number: **'0332112835'**

pH Electrode

Type: **InLab Expert Pro-ISM**S/N: **0373618**

Certified standards used

Standard 1:	Type: pH Buffer	Manufacturer: METTLER TOLEDO	Exp. date: Aug-22
	Nominal value: pH (25.00 °C):	4.01	Lot No.: 1F217A

Standard 2:	Type: pH Buffer	Manufacturer: METTLER TOLEDO	Exp. date: Jul-22
	Nominal value: pH (25.00 °C):	7.00	Lot No.: 1F190D

Standard 3:	Type: pH Buffer	Manufacturer: METTLER TOLEDO	Exp. date: Nov-21
	Nominal value: pH (25.00 °C):	9.21	Lot No.: 1E312C

Test equipment:	Type: pH Meter	Manufacturer: METTLER TOLEDO	Cal date: 21-Apr-21
	S/N: B448305208	No. of certificate: CCP-0443-21	Model: S220

Adjustment

Set Calibration Buffer		B2: (25 °C) 7.00, 4.01, 9.21					
Select Calibration Mode	3-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration
3-Point Calibration	°C	pH	°C	pH	°C	pH	°C
Cal 1	ATC	25.8	7.00	ATC	---	---	ATC
Cal 2	ATC	28.0	4.01	ATC	---	---	ATC
Offset (mV)							
Slope % (or mV/pH)							
Cal 3	ATC	25.7	9.20				
Slope % (or mV/pH)							

Measurements

Before adjustment					After adjustment				
Buffer Values	Measured	Difference	Buffer Values	Measured	Difference	Buffer Values	Measured	Difference	Difference
pH	°C	pH	pH	°C	pH	pH	°C	pH	pH
4.01	25.0	ATC	4.02	0.01	4.01	25.8	ATC	0.00	0.00
7.00	25.8	ATC	7.01	0.01	7.00	25.5	ATC	6.99	-0.01
9.20	25.7	ATC	9.21	0.01	9.20	25.6	ATC	9.20	0.00

Remarks: The difference result of calibrated electrode should be within +/- 0.05 pH

Place: LaboratoryCalibration Date: April 21, 2021Service Specialist: Punchanakrit RujlpreparatSignature: Electronic Signature

COPY

pH Meter

Model : SevenCompactTM pH/Ion Meter S220

Serial No. : B448305208

Certificate Number CCP-1416-22**Calibration Certificate**
SevenCompact™ pH/Ion Meter S220**Customer**Company EASTERN THAI CONSULTING 1992 CO., LTD.Address 883 Moo 11, Sukhaphan 8 Rd., Nong KhamSiachaChonburi 20230Customer ID number 301608441Customer representative Sasipom Nakin

Assignment ID

**Instrument**Type SevenCompact™ S220Instrument Serial Number B448305208Internal identification LABE 11/4Firmware version 1.20.06**Technical specifications**Measuring Range -1999.9 ... 1999.9 mV -2.000 ... 20.000 pHResolution 0.1 mV 0.001 pHLimit of Error ± 0.2 mV ± 0.002 pHTemperature range MTC -30.0 ... 130.0 °CTemperature range ATC -5.0 ... 130.0 °CResolution 0.1 °CLimit of Error ± 0.1 °C**Procedure Statement**

METTLER TOLEDO Certification SOP (Doc. No. ME-30027578) will be used as referring documentation to adjust and certify the instrument indicated in the "Type" and "Serial number" section. The measurement results of this certification were obtained at ambient conditions.

COPYCertificate Number CCP-1416-22**Certification Tools**Certified digital voltmeter Manufacturer GOSSEN METRAWATTControl No. ANA77Serial number ZD1740Certificate number E1U213196Due date August 8, 2022Certified Temperature Resistors Manufacturer METTLER TOLEDO / ME-S1302410Control No. ANA137Serial number A424Certificate number 31344Due date August 25, 2023

Designation	Nominal value	Certified value
NTC 30 kΩ, 0 °C	94.980 kΩ	94.9556 kΩ
NTC 30 kΩ, 25 °C	30.000 kΩ	30.0137 kΩ
NTC 30 kΩ, 50 °C	10.969 kΩ	10.9649 kΩ
NTC 30 kΩ, 75 °C	4.528 kΩ	4.5257 kΩ
NTC 30 kΩ, 100 °C	2.070 kΩ	2.06949 kΩ
PT1000, 0 °C	1.000 kΩ	1.000156 kΩ
PT1000, 25 °C	1.0974 kΩ	1.097484 kΩ
PT1000, 50 °C	1.1940 kΩ	1.194202 kΩ
PT1000, 75 °C	1.2899 kΩ	1.290138 kΩ
PT1000, 100 °C	1.3851 kΩ	1.385061 kΩ

COPY

Certificate Number CCP-1416-22

Certification Measurements

Designation	Certified value	Measured value	Max. Tolerance	Passed / Failed
pH/mV Sensor Input				
-1900 mV	-1900.0 mV	-1899.9 mV	0.2 mV	Passed
-1000 mV	-1000.0 mV	-999.9 mV	0.2 mV	Passed
-500 mV	-500.0 mV	-499.9 mV	0.2 mV	Passed
-180 mV	-180.0 mV	-180.0 mV	0.2 mV	Passed
0 mV	0.0 mV	0.1 mV	0.2 mV	Passed
180 mV	180.0 mV	180.0 mV	0.2 mV	Passed
500 mV	500.0 mV	499.9 mV	0.2 mV	Passed
1000 mV	1000.0 mV	999.9 mV	0.2 mV	Passed
1900 mV	1900.0 mV	1899.9 mV	0.2 mV	Passed

Designation	Measured low Imp.	Measured high Imp.	Max. Tolerance	Passed / Failed
pH/mV Sensor Input at high Impedance				
1900 mV	1900.0 mV	1899.6 mV	0.6 mV	Passed

Designation	Nominal value	Measured value	Max. Tolerance	Passed / Failed
Temperature Sensor Input				
NTC 30 kΩ, 0 °C	0.0 °C	0.0 °C	0.1 °C	Passed
NTC 30 kΩ, 25 °C	25.0 °C	25.0 °C	0.1 °C	Passed
NTC 30 kΩ, 50 °C	50.0 °C	50.0 °C	0.1 °C	Passed
NTC 30 kΩ, 75 °C	75.0 °C	74.9 °C	0.1 °C	Passed
NTC 30 kΩ, 100 °C	100.0 °C	99.9 °C	0.1 °C	Passed
PT1000, 0 °C	0.0 °C	0.1 °C	0.1 °C	Passed
PT1000, 25 °C	25.0 °C	25.0 °C	0.1 °C	Passed
PT1000, 50 °C	50.0 °C	50.0 °C	0.1 °C	Passed
PT1000, 75 °C	75.0 °C	75.1 °C	0.1 °C	Passed
PT1000, 100 °C	100.0 °C	100.1 °C	0.1 °C	Passed

Digital sensor Input with pH Sensor	Sensor recognition	The sensor was recognized correctly by the meter	Passed

Summary of Certification

Certification of instrument

Passed

The instrument referred to in this certificate has fulfilled the criteria of the certification. This is indicated by the notation Passed in the column above.

Remarks

Certification of the instrument was performed by

Name Patipat Sweatpanuwat

Function Service Engineer

Place Laboratory room

Calibration Date: February 7, 2022

Signature ELECTRONIC SIGNATURE

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Performance Test

Control No. CCE-1416-22/1

Company: EASTERN THAI CONSULTING 1992 CO., LTD.

Address: 683 Moo 11, Sukhaphiban 8 Rd., Nong Kham-Si-racha

Chonburi 20230

Assignment ID *0332342430*

pH Electrode

Type: Inlab Expert Pro-ISM

SN: 1076465

Certified standards used

Standard 1:	Type: <u>pH Buffer</u>	Manufacturer: <u>METTLER TOLEDO</u>	Exp. date: <u>Dec-22</u>
	Nominal value: <u>pH (25.00 °C):</u>	<u>4.01</u>	Lot No.: <u>1F351C</u>

Standard 2:	Type: <u>pH Buffer</u>	Manufacturer: <u>METTLER TOLEDO</u>	Exp. date: <u>Dec-22</u>
	Nominal value: <u>pH (25.00 °C):</u>	<u>7.00</u>	Lot No.: <u>1F351M</u>

Standard 3:	Type: <u>pH Buffer</u>	Manufacturer: <u>METTLER TOLEDO</u>	Exp. date: <u>Jan-23</u>
	Nominal value: <u>pH (25.00 °C):</u>	<u>9.21</u>	Lot No.: <u>1G012G</u>

Test equipment:	Type: <u>pH Meter</u>	Manufacturer: <u>METTLER TOLEDO</u>	Cal date: <u>7-Feb-22</u>
	S/N: <u>B448305208</u>	No. of certificate: <u>CCP-1416-22</u>	Model: <u>S220</u>

Adjustment

Set Calibration Buffer		B2: (25 °C) 7.00, 4.01, 9.21					
Select Calibration Mode	3-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration	2-Point calibration
3-Point Calibration	°C	pH	°C	pH	°C	pH	°C
Cal 1	ATC	25.0	7.00	ATC	---	---	ATC
Cal 2	ATC	24.9	4.01	ATC	---	---	ATC
Offset (mV)		3.4		---		---	
Slope % (or mV/pH)		97.6		---		---	
Cal 3	ATC	24.7	9.21				
Slope % (or mV/pH)		98.2					

Measurements

Before adjustment				After adjustment			
Buffer Values	Measured	Difference	Buffer Values	Measured	Difference	Buffer Values	Measured
pH °C	pH	pH	pH °C	pH	pH	pH °C	pH
4.01 25.0 ATC	3.95	-0.06	4.01 24.9 ATC	4.02	0.01	7.00 25.0 ATC	7.01
7.00 25.0 ATC	7.03	0.03	7.00 24.8 ATC	7.01	0.01	9.21 24.6 ATC	9.20
9.21 24.6 ATC	9.20	-0.01	9.21 24.7 ATC	9.21	0.00		

Remarks: The difference result of calibrated electrode should be within +/- 0.05 pH

Place: Laboratory room

Calibration Date: February 7, 2022

Service Specialist: Patipat Sweatpanuwat

Signature: Electronic Signature

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Primary Flow Calibrator

Serial No. : 110619

Certificate of Calibration

Customer : Eastern Thai Consulting 1992 Co., Ltd.
 Name : Eastern Thai Consulting 1992 Co., Ltd.
 Address : 683 Moo 11, Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230
 Certificate No : 22-AFM-016 Rev.1
 Request No : Req-2022-0122

Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator
 Manufacturer : BIOS
 Model : Defender 510-L
 Serial Number : 110619
 ID : -
 Location of Calibration : LAB 4 AIR VELOCITY METER
 Sensor Model : -
 Sensor Serial Number : -

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
 Humidity : 55 %RH ± 20 %RH
 Barometric Pressure : 1013 hPa ± 10 hPa
 Received Date : 21 January 2022
 Calibration Date : 27 January 2022

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceble	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	21 May 2022
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	20 May 2022

Traceability :

This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of

Units (SI)

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor k=2, providing a level of confidence approximately 95 %.

This Certificate was issued to replace to Calibration Certificate No. 22-AFM-016

Calibration By : Mr. Noppadon Luangart
 Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn
 Calibration Engineer Supervisor
 Issue Date : 11 February 2022

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The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.00 Issue date 01/07/19

Certificate No : 22-AFM-016 Rev.1

Request No : Req-2022-0122

Result of Calibration :

Flow Setting	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
(cc/min)	(cc/min)	(cc/min)	(cc/min)	(cc/min)
20	20.73	20.697	0.03	0.69
50	49.66	49.541	0.12	0.99
100	102.7	102.93	-0.2	1.9
250	249.0	248.45	0.5	4.8
500	502.0	500.51	1.4	7.9

Note

STD : Standard

UUC : Unit Under Calibration

End of Certificate

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The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.00 Issue date 01/07/19

SPECTROPHOTOMETER

MODEL : PROVE 100

Serial No. : 1613110857

CERTIFICATE OF CALIBRATION

Instrument : SPECTROPHOTOMETER
Model : PROVE 100
Date of Calibration : February 18, 2021
Customer Name : Eastern Thai Consulting 1992 Co., Ltd.

Procedure used

The wavelength accuracy and the linearity of the absorbance measurement of photometers are checked using Check solutions according to Merck calibration laboratory work instruction.

Measurements results

Function : Absorbance measurement.
 All data shown below as received values of blank solution before adjustment.

Check Solution (Abs.)	Wavelength (nm)	Desired Absorbance (Abs.)	Measured Absorbance (Abs.)	Error (Abs)
0.000	445	0.000 ± 0.005	0.000	0.000
0.000	525	0.000 ± 0.005	0.000	0.000
0.000	690	0.000 ± 0.005	0.000	0.000

CERTIFICATE OF CALIBRATION

Function : Absorbance measurement.
 All data shown below were final value of standard solution after adjustment.

Check Solution* (Abs.)	Desired Absorbance (Abs.)	Allowed tolerance (Abs.)	Actual Absorbance (Abs.)	Assessment Yes/No
445-1	0.193	± 0.020	0.192	Yes
445-2	0.494	± 0.030	0.492	Yes
445-3	0.995	± 0.040	0.992	Yes
445-4	1.488	± 0.050	1.495	Yes
525-1	0.192	± 0.020	0.194	Yes
525-2	0.494	± 0.030	0.495	Yes
525-3	0.988	± 0.040	0.984	Yes
525-4	1.486	± 0.050	1.474	Yes
690-1	0.202	± 0.020	0.202	Yes
690-2	0.495	± 0.030	0.498	Yes
690-3	0.984	± 0.040	0.986	Yes
690-4	1.486	± 0.050	1.489	Yes

* Spectroquant Photocheck (Check Solution) Lot : HC996035

- Check solution for this certification is traceable to : Reference Photometer Agilent Cary 4000
 checked and calibrated using NIST-grey glass filter SRM 1930 and Holmiumoxide Solution NIST SRM 2034
 - Desired absorbance round cell has been calculated from the absorbance of the 1 cm cell using the path length of the round cell and is entered as the desired

CERTIFICATE No. **WO-01918550**



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CERTIFICATE OF CALIBRATION

Software version: 1.5.1

Wavelength Accuracy*					
Equipment	Nominal value	Tolerance limit**	Actual value	Result	
Holmium Oxide Liquid Filter Hellma 667-UV5	361.30 nm	360.1 - 362.5 nm	361.0 nm	P	
	536.60 nm	535.4 - 539.3 nm	536.8 nm	P	
	640.55 nm	639.4 - 642.8 nm	641.1 nm	P	
Wavelength Precision / Reproducibility*					
Equipment	Wavelength	Nominal value	Actual value	Result	
Holmium Oxide Liquid Filter Hellma 667-UV5	361.30 nm	≤0.10 nm	0.01 nm	P	
	536.60 nm	≤0.10 nm	0.02 nm	P	
	640.55 nm	≤0.10 nm	0.09 nm	P	
Photometric Accuracy*					
Equipment	Wavelength	Nominal value	Tolerance limit**	Actual value	Result
Neutral Density 1.00 Abs. Hellma 666-F4	440 nm	1.075 A	1.063 - 1.086 A	1.077 A	P
	546 nm	1.012 A	1.004 - 1.020 A	1.016 A	P
	635 nm	1.030 A	1.022 - 1.039 A	1.033 A	P
Neutral Density 2.00 Abs. Hellma 666-F203	440 nm	2.202 A	2.185 - 2.219 A	2.206 A	P
	546 nm	2.005 A	1.992 - 2.018 A	2.011 A	P
	635 nm	1.941 A	1.928 - 1.954 A	1.946 A	P
Photometric Precision / Reproducibility* @ 1.0 A					
Equipment	Wavelength	Nominal value	Actual value	Result	
Neutral Density 1.00 Abs. Hellma 666-F4	440 nm	≤0.003 A	0.000 A	P	
	546 nm	≤0.003 A	0.000 A	P	
	635 nm	≤0.003 A	0.000 A	P	
Stray Light*					
Equipment	Wavelength	Nominal value	Actual value	Result	
Sodium Nitrite Hellma 667-UV11	340 nm	≤0.10 %T	0.02 %T	P	
Self-test Hardware					P
No visual flaws, no burrs, no loose parts and fastenings					

CERTIFICATE OF CALIBRATION

INSTRUMENT : SPECTROPHOTOMETER

MANUFACTURER : Merck KGaA, Darmstadt, Germany

MODEL : PROVE 100

SERIAL No. : 1613110857

CLIENT : Eastern Thai Consulting 1992 Co., Ltd.

DATE OF ISSUE : February 18, 2021

APPROVED SIGNATORY

NAME : Mr. Supachai Konthong
(INSTRUMENTAL SERVICE ENGINEER)

SIGNATURE :

This certificate may not be reproduced except in full unless permission for the reproduction has been obtained in writing from the laboratory.

CERTIFICATE No. WO-01918550



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SPECTROPHOTOMETER

Model : PROVE 100

Serial No. : 1613110857



CERTIFICATE OF CALIBRATION

Instrument : SPECTROPHOTOMETER
Model : PROVE 100
Date of Calibration : February 15, 2022
Customer Name : Eastern Thai Consulting 1992 Co., Ltd.

Procedure used

The wavelength accuracy and the linearity of the absorbance measurement of photometers are checked using Check solutions according to Merck calibration laboratory work instruction.

Measurements results

Function : Absorbance measurement.
All data shown below as received values of blank solution before adjustment.

Check Solution (Abs.)	Wavelength (nm)	Desired Absorbance (Abs.)	Measured Absorbance (Abs.)	Error (Abs)
0.000	445	0.000 ± 0.005	0.000	0.000
0.000	525	0.000 ± 0.005	0.000	0.000
0.000	690	0.000 ± 0.005	0.000	0.000

CERTIFICATE OF CALIBRATION

Function : Absorbance measurement.
All data shown below were final value of standard solution after adjustment.

Check Solution* (Abs.)	Desired Absorbance (Abs.)	Allowed tolerance (Abs.)	Actual Absorbance (Abs.)	Assessment Yes/No
445-1	0.193	± 0.020	0.191	Yes
445-2	0.494	± 0.030	0.495	Yes
445-3	0.995	± 0.040	0.990	Yes
445-4	1.488	± 0.050	1.484	Yes
525-1	0.192	± 0.020	0.195	Yes
525-2	0.494	± 0.030	0.499	Yes
525-3	0.988	± 0.040	0.986	Yes
525-4	1.486	± 0.050	1.484	Yes
690-1	0.202	± 0.020	0.206	Yes
690-2	0.495	± 0.030	0.495	Yes
690-3	0.984	± 0.040	0.993	Yes
690-4	1.486	± 0.050	1.490	Yes

* Spectroquant Photocheck (Check Solution) Lot : HC996035

- Check solution for this certification is traceable to : Reference Photometer Agilent Cary 4000 checked and calibrated using NIST-grey glass filter SRM 1930 and Holmiumoxide Solution NIST SRM 2034
- Desired absorbance round cell has been calculated from the absorbance of the 1 cm cell using the path length of the round cell and is entered as the desired

CERTIFICATE No. **WO-02118723**



Merck Ltd. Thailand
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Customer Care Center : +66 (0) 2667 8333

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CERTIFICATE OF CALIBRATION

Software version: 1.5.1

Wavelength Accuracy*					
Equipment	Nominal value	Tolerance limit**	Actual value	Result	
Holmium Oxide Liquid Filter Hellma 667-UV5	361.30 nm	360.1 - 362.5 nm	360.9 nm	P	
	536.60 nm	535.4 - 539.3 nm	536.8 nm	P	
	640.55 nm	639.4 - 642.8 nm	641.1 nm	P	
Wavelength Precision / Reproducibility*					
Equipment	Wavelength	Nominal value	Actual value	Result	
Holmium Oxide Liquid Filter Hellma 667-UV5	361.30 nm	≤0.20 nm	0.02 nm	P	
	536.60 nm	≤0.20 nm	0.05 nm	P	
	640.55 nm	≤0.20 nm	0.06 nm	P	
Photometric Accuracy*					
Equipment	Wavelength	Nominal value	Tolerance limit**	Actual value	Result
Neutral Density 1.00 Abs. Hellma 666-F4	440 nm	1.065 A	1.053 - 1.077 A	1.068 A	P
	546 nm	1.012 A	1.003 - 1.020 A	1.017 A	P
	635 nm	1.054 A	1.042 - 1.066 A	1.060 A	P
Neutral Density 2.00 Abs. Hellma 666-F203	440 nm	2.217 A	2.200 - 2.234 A	2.220 A	P
	546 nm	1.998 A	1.986 - 2.011 A	2.005 A	P
	635 nm	1.914 A	1.901 - 1.927 A	1.918 A	P
Photometric Precision / Reproducibility* @ 1.0 A					
Equipment	Wavelength	Nominal value	Actual value	Result	
Neutral Density 1.00 Abs. Hellma 666-F4	440 nm	≤0.003 A	0.001 A	P	
	546 nm	≤0.003 A	0.000 A	P	
	635 nm	≤0.003 A	0.000 A	P	
Stray Light*					
Equipment	Wavelength	Nominal value	Actual value	Result	
Sodium Nitrite Hellma 667-UV11	340 nm	≤0.10 %T	0.00 %T	P	
Selftest Hardware					P
No visual flaws, no burrs, no loose parts and fastenings					



CERTIFICATE OF CALIBRATION

INSTRUMENT : SPECTROPHOTOMETER

MANUFACTURER : Merck KGaA, Darmstadt, Germany

MODEL : PROVE 100

SERIAL No. : 1613110857

CLIENT : Eastern Thai Consulting 1992 Co., Ltd.

DATE OF ISSUE : February 15, 2022

APPROVED SIGNATORY

NAME : Mr. Rawat Rattanachetthakul
(SERVICE ENGINEER)

SIGNATURE : _____

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CERTIFICATE No. **WO-02118723**



Merck Ltd. Thailand

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Tel : +66 (0) 2667 8000
Fax : +66 (0) 2667 8399
Customer Care Center : +66 (0) 2667 8333

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STANDARD WEIGHT 50 g



Certificate No. : 22-052238
Sample Code : 22-19150-003

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of Calibration : Asia Medical and Agricultural Laboratory and Research Center Public Company Limited
(Calibration Laboratory)

Equipment : Standard Weight 50 g

Manufacturer : METTLER TOLEDO

Class : F1

Serial No. : N/A

ID No. : LABE 10/1

Date of Receipt : 18 May 2022

Date of Calibration : 30 May 2022

Calibrated by : Mr. Somwang Sangdee
Scientist

Approved by

(Mr. Somchai Neampunt)

Signed for Director

Issue date : 31 May 2022

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).



Certificate No. : 22-052238
Sample Code : 22-19150-003

REPORT OF CALIBRATION

Equipment : Standard Weight 50 g
Manufacturer : METTLER TOLEDO
Class : F1
Serial No. : N/A
ID No. : LABE 10/1

Result of Calibration :

☒ Without adjustment

☐ Adjustment

Conventional value of the result of weighing in air. For a weight taken at a reference temperature (t_{ref}) of 20°C, the conventional mass is the mass of a reference weight of a density (ρ_{ref}) of 8000 kg.m⁻³ which it balances in air of a reference density (ρ_0) of 1.2 kg.m⁻³

Description	Deviation	Conventional Mass	Expanded Uncertainty	Maximum Permissible Error	ID No.
	(mg)		(mg)	± (mg)	
50 g	-0.324	49.999676 g	0.10	0.30	LABE 10/1

The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.0$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003

COPY



Certificate No. : 22-052238

Sample Code : 22-19150-003

REPORT OF CALIBRATION

Condition of Calibration

1. Ambient Conditions : Temperature $20^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$, Relative humidity $50\% \pm 10\%$ and air density 1.20 kg/m^3

2. Calibration Method : Direct comparison weighing according to OIML R111-1 : 2004(E)

3. Reference standard instrument

Instrument	Class	ID No.	Certificate No.	Due Date
1) Standard Weight 1 mg to 1 kg	E2	LB-WE-79	21-079366	22 September 2022

4. This certification is traceable to the International System of Unit maintained at : -

Asia Medical and Agricultural Laboratory and Research Center Public Company Limited

(Instrument number 1).

5. Condition of Calibration item: Normal

6. Description of Calibrated Item :

Type and Nominal Value :	Standard Weight 50 g
Shape :	Cylindrical weight with knot
Material :	Stainless steel
Case :	Wooden Box
Comments :	Recalibration

- End of Report -

COPY

STANDARD WEIGHT 100 g

Certificate No. : 22-052239
 Sample Code : 22-19150-004

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
 683 Moo 11, Sukhapiban 8 Rd., Nongkham,
 Sriracha, Chonburi 20230

Location of Calibration : Asia Medical and Agricultural Laboratory and Research Center Public Company Limited
 (Calibration Laboratory)

Equipment : Standard Weight 100 g

Manufacturer : N/A

Class : N/A

Serial No. : N/A

ID No. : LABE 10/2

Date of Receipt : 18 May 2022

Date of Calibration : 30 May 2022

Calibrated by Mr. Somwang Sangdee
 Scientist
 Issue date 31 May 2022

Approved by

(Mr. Somchai Neampunt)
 Signed for Director

COPY

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).

Certificate No. : 22-052239
 Sample Code : 22-19150-004

REPORT OF CALIBRATION

Equipment : Standard Weight 100 g

Manufacturer : N/A

Class : N/A

Serial No. : N/A

ID No. : LABE 10/2

Result of Calibration : ☒ Without adjustment ☐ Adjustment

Conventional value of the result of weighing in air. For a weight taken at a reference temperature (t_{ref}) of 20°C, the conventional mass is the mass of a reference weight of a density (ρ_{ref}) of 8000 kg.m⁻³ which it balances in air of a reference density (ρ_a) of 1.2 kg.m⁻³

Description	Deviation	Conventional Mass	Expanded Uncertainty	Maximum Permissible Error	ID No.
	(mg)		(mg)	± (mg)	
100 g	-0.171	99.999829 g	0.16	0.50	LABE 10/2

The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.0$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003

COPY

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Certificate No. : 22-052239

Sample Code : 22-19150-004

REPORT OF CALIBRATION

Condition of Calibration

1. Ambient Conditions : Temperature $20^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$, Relative humidity $50\% \pm 10\%$ and air density 1.18 kg/m^3

2. Calibration Method : WI-CL-007 base on OIML R 111-1 : 2004(E)

3. Reference standard instrument

Instrument	Class	ID No.	Certificate No.	Due Date
1) Standard Weight 1 mg to 1 kg	E2	LB-WE-79	21-079366	22 September 2022

4. This certification is traceable to the International System of Unit maintained at : -

Asia Medical and Agricultural Laboratory and Research Center Public Company Limited

(Instrument number 1).

5. Condition of Calibration item: Normal

6. Description of Calibrated Item :

Type and Nominal Value :	Standard Weight 100 g
Shape :	Cylindrical weight with knob
Material :	Stainless steel
Case :	Wooden Box
Comments :	Recalibration

- End of Report -



COPY

STANDARD WEIGHT 50 g



Certificate No. : 22-052237
Sample Code : 22-19150-002

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO., LTD.
683 Moo 11, Sukhapiban 8 Rd., Nongkham,
Sriracha, Chonburi 20230

Location of Calibration : Asia Medical and Agricultural Laboratory and Research Center Public Company Limited
(Calibration Laboratory)

Equipment : Standard Weight 50 g

Manufacturer : N/A

Class : N/A

Serial No. : N/A

ID No. : LABE 10/4

Date of Receipt : 18 May 2022

Date of Calibration : 30 May 2022

Calibrated by : Mr. Somwang Sangdee

Scientist

Issue date : 31 May 2022

Approved by

(Mr. Somchai Neampunt)

Signed for Director

COPY

The uncertainties are for a confidence probability of approximately 95%.

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Public Company Limited (AMARC).



Certificate No. : 22-052237
Sample Code : 22-19150-002

REPORT OF CALIBRATION

Equipment : Standard Weight 50 g
Manufacturer : N/A
Class : N/A
Serial No. : N/A
ID No. : LABE 10/4

Result of Calibration :

☒ Without adjustment

☐ Adjustment

Conventional value of the result of weighing in air. For a weight taken at a reference temperature (t_{ref}) of 20°C, the conventional mass is the mass of a reference weight of a density (ρ_{ref}) of 8000 kg.m⁻³ which it balances in air of a reference density (ρ_0) of 1.2 kg.m⁻³

Description	Deviation	Conventional Mass	Expanded Uncertainty	Maximum Permissible Error	ID No.
	(mg)		(mg)	± (mg)	
50 g	-0.111	49.999889 g	0.10	0.30	LABE 10/4

The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.0$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003

COPY

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Certificate No. : 22-052237
Sample Code : 22-19150-002

REPORT OF CALIBRATION

Condition of Calibration

1. Ambient Conditions : Temperature $20^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$, Relative humidity $50\% \pm 10\%$ and air density 1.18 kg/m^3

2. Calibration Method : WI-CL-007 base on OIML R 111-1 : 2004(E)

3. Reference standard instrument

Instrument	Class	ID No.	Certificate No.	Due Date
1) Standard Weight 1 mg to 1 kg	E2	LB-WE-79	21-079366	22 September 2022

4. This certification is traceable to the International System of Unit maintained at : -

Asia Medical and Agricultural Laboratory and Research Center Public Company Limited

(Instrument number 1).

5. Condition of Calibration item: Normal

6. Description of Calibrated Item :

Type and Nominal Value :	Standard Weight 50 g
Shape :	Cylindrical weight with knob
Material :	Stainless steel
Case :	Wooden Box
Comments :	Recalibration

- End of Report -

Handwritten signature
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THERMO-HYGROMETER

Model : 608-H1

Serial No. : 45106737



ASIA MEDICAL AND AGRICULTURAL LABORATORY
AND RESEARCH CENTER CO., LTD.

361,361/1-4 Soi Ladprao 122, (Mahadthai 1), Ladprao Road, Phlabphla,
Wangthonglang, Bangkok, Thailand 10310, Head Office
Tel.(66) 2-934-2381-3 Fax.(66) 2-934-0661
http://www.amarc.co.th Email: cl@amarc.co.th



NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-062722
Sample code : 21-24788-002

Page 1 of 2

CERTIFICATE OF CALIBRATION

Customer : EASTERN THAI CONSULTING 1992 CO.,LTD

683 Moo 11, Sukhapiban 8 Rd, Nongkham,
Sriracha, Chonburi 20230

Location of calibration : Asia Medical and Agricultural Laboratory and Research Center Co., Ltd.
(Calibration laboratory)

Equipment : Digital thermo-hygrometer

Manufacturer : Testo Model : 608-H1

Serial No. : 45106737 ID No. : LABE 09/7

Date of receipt : 23 July 2021 Date of calibration : 29 July 2021

Condition of calibration

1 Environment Ambient temperature : 23.0 °C ± 3.0 °C
Relative humidity : 55.0 % ± 15.0 %

2 Calibration method

2.1 In-house method : WI-CL-045 By comparison with thermometer standard / chilled mirror hygrometer in controlled chamber.

2.2 The calibration by comparison unit under calibration (UUC) to the thermometer standard / chilled mirror hygrometer in controlled chamber in a chamber at the controlled temperature/ relative humidity.

3 Reference standard instrument

Instrument	Model	Code No.	Certificate No.	Due date
3.1 Chilled Mirror	Optidew Vision	LB-DP-02 & LB-DP-02 (DP)	TH-0018-21	10 March 2022
3.2 Digital Thermometer	Optidew Vision	LB-DP-02 & LB-DP-02 (Temp.)	21-032217	06 April 2022
3.3 Digital Thermometer	34972A	LB-DA-07 with RTD-89	20-085967	17 September 2021

4 This certificate is traceable to the international system of unit (SI Unit)

4.1 Instrument No.3.1 through : National Institute of Metrology (Thailand)

4.2 Instrument No.3.2 and 3.3 through : Asia Medical and Agricultural Laboratory and Research Center Co., Ltd.

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

6 Condition of calibration item : Normal

Calibrated by Miss Pornsuda Lohabal
Scientist

Approved by (Mr . Somchai Neampunt)
Signed for Director

Date of issue : 11 August 2021

The uncertainties are for a confidence probability of approximately 95%

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Asia Medical and Agricultural Laboratory and Research Center Co., Ltd. (AMARC)



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NSC-TISI-TIS 17025
CALIBRATION 0152

Certificate No. : 21-062722
Sample code : 21-24788-002

Page 2 of 2

REPORT OF CALIBRATION

Results of calibration

Temperature measurement

Resolution of unit under calibration : 0.1 °C

Range : 0 °C to 50 °C

Calibration point °C	Average of standard reading		Unit under calibration		Expanded uncertainty °C
	Controlled humidity %RH	Temperature °C	Average reading °C	Correction value °C	
20	50	20.02	20.1	- 0.08	± 0.40
25	50	25.02	25.0	+ 0.02	± 0.40
30	50	30.00	29.7	+ 0.30	± 0.40

Humidity measurement

Resolution of unit under calibration : 0.1 %RH

Range : 10 %RH to 95 %RH

Calibration point %RH	Average of standard reading		Unit under calibration		Expanded uncertainty %RH
	Air temperature °C	Calculated humidity %RH	Average reading %RH	Correction value %RH	
45	25.00	45.13	52.4	- 7.27	± 1.3
60	25.00	60.03	67.5	- 7.47	± 1.5
75	25.00	75.20	82.5	- 7.30	± 1.7

Note

Calibration results without adjustment

The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2.00, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with UKAS M3003

End of report

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UV/VIS SPECTROPHOTOMETER

Model : UV – 1800

Serial No. : A11635101643CD



Bara Scientific

Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor7 Rama4 Road
Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-152/21
Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11635101643CD
ID No. LABE 03/2
Date of receipt 24 May 2021
Date of calibration 24 May 2021
Date of issue 1 June 2021

Customer name Eastern Thai Consulting 1992 Co., Ltd.

Address 683 Moo 11, Sukkaphibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

Temperature (20.1-22.2) °C (On site)
Humidity (43.9-49.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Analysis Department.

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 87839 and 87844
Photometric Accuracy is traceable to certificate No. 87846 and 87877
Stray Light is traceable to certificate No. 87825
The above certificate are traceable to SI unit through Starna Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr.Kanchit Choothep

Approved by

Mr.Kanchit Choothep
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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except in full, without written approval of the Bara Scientific Co., Ltd



Bara Scientific

Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor7 Rama4 Road
Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Certificate No. BSCC-UV-152/21

Number of Page(s) 2 of 3

Calibration Results:

1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (\pm nm)
287.71	287.70	-0.01	0.18
445.82	445.85	0.03	0.18
536.52	536.45	-0.07	0.18
741.02	741.05	0.03	0.18
879.41	879.35	-0.06	0.18

2.Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (\pm A)
235	0.0000 0.7174	0.0000 0.7178	0.0000 0.0004	0.0075 0.0075
257	CNR CNR	CNR CNR	CNR CNR	CNR CNR
313	CNR CNR	CNR CNR	CNR CNR	CNR CNR
350	0.0000 0.6202	0.0000 0.6214	0.0000 0.0012	0.0075 0.0075

*CNR = Customer not request

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Certificate of Calibration

Certificate No. **BSCC-UV-152/21** Number of Page(s) **3 of 3**

Calibration Results:

3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty ($\pm A$)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5631	0.5615	-0.0016	0.0042
	0.7390	0.7376	-0.0014	0.0042
	1.0863	1.0846	-0.0017	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5524	0.5501	-0.0023	0.0042
	0.7217	0.7199	-0.0018	0.0042
	1.0606	1.0587	-0.0019	0.0042
465.0	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
546.1	0.0000	0.0000	0.0000	0.0042
	0.5147	0.5124	-0.0023	0.0042
	0.6743	0.6720	-0.0023	0.0042
	0.9909	0.9882	-0.0027	0.0042
590.0	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
635.0	0.0000	0.0000	0.0000	0.0042
	0.5268	0.5271	0.0003	0.0042
	0.6720	0.6708	-0.0012	0.0042
	0.9864	0.9854	-0.0010	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC)		
	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.86 \pm 0.11nm	201.05	0.9723	2.0123

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

*Stray Light not NSC-ONSC Accredited.

The measurement uncertainty is base on a standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

End of Certificate

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced except in full, without written approval of the Bara Scientific Co., Ltd.

SOUND LEVEL CALIBRATOR

MODEL : NC-75

SERIAL No. : 34802645



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0018

MTC No. EEL. BP. 24/1064

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co.,Ltd.

Address : 683 Moo 11 Sukaphibai 8 Rd., Nongkham, Sriracha, Chonburi 20230.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : Rion

Model : NC-75

Serial No. : 34802645

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone B&K 4180 S/N 2889871.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at 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.

Date of Receipt : 11 Oct. 2021

Date of Calibration : 21 Oct. 2021

COPY 1/2

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

5 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
ngwat Pathumthani 12120, Thailand
(66) 0 2577 9000
(66) 0 2577 9009
ail : 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

FM.BL.MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0018

MTC No. EEL. BP. 24/1064

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%.

Nominal Output of Unit Under Test = 94 dB re 20μPa at 1000 Hz

Acoustic Output in dB re 20μPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch B&K 4180	93.97	-0.03	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch B&K 4180	1000.0	0.0	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch B&K 4180	0.50	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Mr. Weerachai Deechaiyae
(Mr.Weerachai Deechaiyae)

Approved by :

Mr. Prawate Khuaypa
(Mr.Prawate Khuaypa)
Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 21 Oct. 2021

Date of Issue : 26 Oct. 2021

Ref: 2011264101104187003

End of Certificate

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FM.BL.MTC.002 Rev.4

SOUND LEVEL METER

MODEL : CR:172A

SERIAL No. : G301635



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0818

MTC No. EEL. BP. 13/0964

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.
Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.
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 : $(23 \pm 3) ^\circ\text{C}$
Manufacturer : Cirrus	Relative Humidity : $(50 \pm 15) \%$
Model : CR:172A	Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$
Serial No. : G301635 (No.32)	
Microphone : Cirrus MK216 No.412753F	
Preamplifier : No.10402F	

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Sep. 2021
Date of Calibration : 20-22 Sep. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0818

MTC No. EEL. BP. 13/0964

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 (2006). 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 : 20-22 Sep. 2021

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	Uncertainty (±dB)	
94.06	93.9	-0.2	0.50	1.4

Note: The internal calibration display at 93.7 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
17.3	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	under-range	-
C-Weighting	20.1	0.10
Flat	31.1	0.10

Note: The under-range means the indicator cannot display the value because it is under the setting range 20-140 dB.

Date of Calibration : 20-22 Sep. 2021

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.1	-0.1	-0.1	0.40	2.0
1 000	-0.4	-0.4	-0.4	0.40	1.4
4 000	0.7	0.8	1.0	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.3	0.1	0.1	0.20	2.5
125	0.3	0.1	0.0	0.20	2.0
250	0.2	0.0	0.0	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.2	-0.1	0.0	0.20	2.6
4 000	-0.3	-0.2	0.0	0.20	3.6
8 000	-0.5	-0.4	-0.1	0.20	5.6

Date of Calibration : 20-22 Sep. 2021

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
139	139.1	0.1	0.30	1.4
134	134.1	0.1	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	43.9	-0.1	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.1	0.1	0.30	1.4
24	24.2	0.2	0.30	1.4

Date of Calibration : 20-22 Sep. 2021

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Request No. 21-64/0818

MTC No. EEL. BP. 13/0964

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	±1.3
	2	118.9	-0.1	0.20	+1.3; -2.8
	0.25	109.9	-0.1	0.20	+1.8; -5.3
Slow	200	129.5	-0.1	0.20	±1.3
	2	110.0	0.0	0.20	+1.3; -5.3
SEL	200	130.0	0.0	0.20	±1.3
	2	110.0	0.0	0.20	+1.3; -2.8
	0.25	100.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 20-22 Sep. 2021

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Request No. 21-64/0818

MTC No. EEL. BP. 13/0964

9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	135.4	135.6	0.2	0.20	2.4
Positive half cycle	134.4	134.2	-0.2	0.20	1.4
Negative half cycle	134.4	134.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
139.1	139.2	-0.1	0.30	1.8

Calibrated by :

Panya Phasingsri
(Mr. Panya Phasingsri)
Talk 2
(Mr. Tawikiat Iamsamran)

Date of Calibration : 20-22 Sep. 2021

Date of Issue : 4 Oct. 2021

Approved by :

Mr. Tawikiat Iamsamran
(Mr. Tawikiat Iamsamran)
Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264090203654002

End of Certificate

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SOUND LEVEL METER

MODEL : CR:172A

SERIAL No. : G301638

Request No. 21-65/0292

MTC No. EEL. BP. 28/0265

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

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	: Cirrus	Relative Humidity	: (50 ± 15) %
Model	: CR-172A	Ambient Pressure	: (101.325±1.5) kPa
Serial No.	: G301638		
Microphone	: Cirrus MK216 No.412753E		
Preamplifier	: No.10402F		

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Feb. 2022

Date of Calibration : 1 Mar. 2022

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Request No. 21-65/0292

MTC No. EEL. BP. 28/0265

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 (2006). 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 Mar. 2022

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	Limit Class 2 (±dB)
	Before adjust	After adjust			
93.72	93.6	93.7	0.0	0.50	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 93.7 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
17.3	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	18.2	0.10
C-Weighting	25.0	0.10
Flat	31.0	0.10

Date of Calibration : 1 Mar. 2022

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
125	0.0	-0.2	-0.2	0.40	2.0
1 000	-0.5	-0.5	-0.5	0.40	1.4
4 000	0.0	0.1	0.3	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
63	0.7	0.1	0.2	0.20	2.5
125	0.3	0.2	0.1	0.20	2.0
250	0.2	0.1	0.0	0.20	1.9
500	0.2	0.1	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.0	0.0	0.20	2.6
4 000	0.0	-0.2	0.0	0.20	3.6
8 000	-0.2	-0.3	0.0	0.20	5.6

Date of Calibration : 1 Mar. 2022

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Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
139	139.1	0.1	0.30	1.4
134	134.1	0.1	0.30	1.4
129	129.1	0.1	0.30	1.4
124	124.1	0.1	0.30	1.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
119	119.1	0.1	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.1	0.1	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.1	0.1	0.30	1.4
84	84.0	0.0	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	63.9	-0.1	0.30	1.4
59	59.0	0.0	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.0	0.0	0.30	1.4
24	24.2	0.2	0.30	1.4

Date of Calibration : 1 Mar. 2022

Date of Calibration : 1 Mar. 2022

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	±1.3
	2	118.8	-0.2	0.20	+1.3; -2.8
	0.25	109.8	-0.2	0.20	+1.8; -5.3
Slow	200	129.5	-0.1	0.20	±1.3
	2	109.9	-0.1	0.20	+1.3; -5.3
	0.25	100.9	-0.1	0.20	+1.8; -5.3

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	135.4	135.7	0.3	0.20	2.4
Positive half cycle	134.4	134.3	-0.1	0.20	1.4
Negative half cycle	134.4	134.3	-0.1	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
139.1	139.1	0.0	0.30	1.8

Calibrated by :

Pannasit Ph.
(Mr. Pannasit Phasingsri)
Wittawat Supanich
(Mr. Wittawat Supanich)

Date of Calibration : 1 Mar. 2022

Date of Issue : 3 Mar. 2022

Approved by :

Phawate Kruaypa
(Mr. Phawate Kruaypa)
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011265020200458003

End of Certificate

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SOUND LEVEL METER

MODEL : NL-21

SERIAL No. : 00443357



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL. BP. 15/1164

CALIBRATION CERTIFICATE

COPY

Submitted by : Eastern Thai Consulting 1992 Co.,Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi, 20230.

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 : Rion

Model : NL-21

Serial No. : 00443357 (No.12)

Microphone : Type UC-52 No.153070

Preamplifier : Type NH-21 No.11330

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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 Nov. 2021

Date of Calibration : 8-10 Nov. 2021

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Request No. 21-65/0071

MTC No. EEL. BP. 15/1164

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 (2006). 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 : 8-10 Nov. 2021

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1. Absolute Sensitivity

Reference	Unit Under Test				Tolerance
Acoustic Signal (dB)	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	Limit Class 2 (±dB)
	Before adjust	After adjust			
113.90	114.0	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 116.2 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
23.0	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	21.0	0.10
C-Weighting	28.0	0.10
Flat	34.1	0.10

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
125	0.4	0.4	0.2	0.40	2.0
1 000	-0.3	-0.3	-0.2	0.40	1.4
4 000	-0.8	-0.7	-0.8	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
63	0.0	0.0	-0.2	0.20	2.5
125	0.0	0.0	-0.1	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.0	0.1	0.1	0.20	3.6
8 000	0.2	0.2	0.1	0.20	5.6

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Request No. 21-65/0071

MTC No. EEL. BP. 15/1164

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

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6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.1	0.1	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
33	33.1	0.1	0.30	1.4
32	32.1	0.1	0.30	1.4
31	31.1	0.1	0.30	1.4
30	30.1	0.1	0.30	1.4
29	29.2	0.2	0.30	1.4
28	28.2	0.2	0.30	1.4

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.0	0.0	0.20	±1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
SEL	200	110.0	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.1	-0.3	0.20	2.4
Positive half cycle	124.4	124.2	-0.2	0.20	1.4
Negative half cycle	124.4	124.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
135.6	135.6	0.0	0.30	1.8

Calibrated by :



(Mr. Panya Phasingsri)



(Mr. Tawkiat Iamsamran)

Date of Calibration : 8-10 Nov. 2021

Date of Issue : 16 Nov. 2021

Approved by :



(Mr. Pawate Klunaypa)



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref: 2011264110504565002

End of Certificate

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E-mail : mte@tistr.or.th

SOUND LEVEL METER

MODEL : NL-21

SERIAL No. : 01209915



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0703

MTC No. EEL. BP. 44/0764

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

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 : Rion

Model : NL-21

Serial No. : 01209915 (No.20)

Microphone : Type UC-52 No.177387

Preamplifier : Type NH-21 No.34624

Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
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 : 13 Jul. 2021

Date of Calibration : 16-17 Aug. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0703

MTC No. EEL. BP. 44/0764

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 (2006). 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 : 16-17 Aug. 2021

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

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1. Absolute Sensitivity

Reference	Unit Under Test				Tolerance
Acoustic Signal (dB)	Measured Value (dB)		Deviation	Uncertainty	Limit Class 2
	Before adjust	After adjust	(dB)	(±dB)	(±dB)
113.90	114.2	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 110.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.4	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	16.7	2.40
C-Weighting	22.8	2.90
Flat	27.9	1.25

Date of Calibration : 16-17 Aug. 2021

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
125	0.3	0.1	0.1	0.40	2.0
1 000	-0.4	-0.4	-0.4	0.40	1.4
4 000	-1.3	-1.3	-1.2	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
63	0.0	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	-0.1	0.20	2.0
250	0.0	-0.1	-0.1	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.1	0.1	0.1	0.20	3.6
8 000	0.2	0.3	0.1	0.20	5.6

Date of Calibration : 16-17 Aug. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0703

MTC No. EEL. BP. 44/0764

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 16-17 Aug. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0703

MTC No. EEL. BP. 44/0764

6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.1	0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
33	32.9	-0.1	0.30	1.4
32	31.8	-0.2	0.30	1.4
31	30.9	-0.1	0.30	1.4
30	29.8	-0.2	0.30	1.4
29	28.8	-0.2	0.30	1.4
28	27.8	-0.2	0.30	1.4

Date of Calibration : 16-17 Aug. 2021

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Request No. 21-64/0703

MTC No. EEL. BP. 44/0764

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.1	0.1	0.20	±1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.5	-0.1	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
SEL	200	110.0	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 16-17 Aug. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0703

MTC No. EEL. BP. 44/0764

9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.1	-0.3	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
135.6	135.6	0.0	0.30	1.8

Calibrated by :

(Mr. Panya Phasingsri)

Approved by :

(Mr. Panya Phasingsri)
Acting Director
TISTR

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 16-17 Aug. 2021

Date of Issue : 24 Aug. 2021

Ref : 2011264071303008001

End of Certificate

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FM.BL.MTC.002 Rev.4

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SOUND LEVEL METER

MODEL : NL-21

SERIAL No. : 01209912

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

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 : $(23 \pm 3) ^\circ\text{C}$

Manufacturer : Rion

Relative Humidity : $(50 \pm 15) \%$

Model : NL-21

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Serial No. : 01209912 (No.18)

Microphone : Type UC-52 No.157154

Preamplifier : Type NH-19 No.54250

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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 : 11 Oct. 2021

Date of Calibration : 20-27 Oct. 2021

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E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

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 (2006). 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 : 20-27 Oct. 2021

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E-mail : sumalee@tistr.or.th

Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	Limit Class 2 (±dB)
	Before adjust	After adjust			
113.94	114.4	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 117.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.8	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	15.9	0.10
C-Weighting	22.7	0.10
Flat	27.5	0.10

Date of Calibration : 20-27 Oct. 2021

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

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Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
125	0.1	0.2	0.1	0.40	2.0
1 000	-0.4	-0.3	-0.3	0.40	1.4
4 000	0.8	0.7	0.7	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
63	0.0	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	0.0	0.20	2.0
250	0.0	-0.1	-0.1	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.0	0.1	0.1	0.20	3.6
8 000	0.2	0.2	0.1	0.20	5.6

Date of Calibration : 20-27 Oct. 2021

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Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 20-27 Oct. 2021

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Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

6. Level linearity on the reference level range (continue)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.1	0.1	0.30	1.4
69	69.1	0.1	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.1	0.1	0.30	1.4
54	54.0	0.0	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.1	0.1	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
33	33.0	0.0	0.30	1.4
32	31.9	-0.1	0.30	1.4
31	31.0	0.0	0.30	1.4
30	30.0	0.0	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	27.9	-0.1	0.30	1.4

Date of Calibration : 20-27 Oct. 2021

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MTC No. EEL. BP. 22/1064

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.1	0.1	0.20	+1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	+1.3
	2	90.0	0.0	0.20	+1.3; -5.3
SEL	200	110.0	0.0	0.20	+1.3
	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 20-27 Oct. 2021

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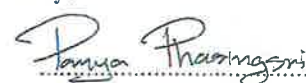
9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (+dB)	Tolerance limits Class 2 (+dB)
Complete cycle	125.4	125.0	-0.4	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Positive one-half cycle	Negative one-half cycle			
135.6	135.6	0.0	0.30	1.8

Calibrated by :



(Mr. Panya Phasingsri)



(Mr. Tawikiat Iamsamran)

Date of Calibration : 20-27 Oct. 2021

Date of Issue : 28 Oct. 2021

Approved by :



(Mr. Panya Phasingsri)



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264101104187001

End of Certificate

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SOUND LEVEL METER

MODEL : NL-21

SERIAL No. : 00310456



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0618

MTC No. EEL. BP. 40/0664

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11, Sukhapibarn 8, Nongkham, Sriracha, Chonburi 20230.

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 : Rion

Model : NL-21

Serial No. : 00310456

Microphone : Type UC-52 No.153489

Preamplifier : Type NH-21 No.34625

Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
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 : 8 Jun. 2021

Date of Calibration : 1-2 Jul. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0618

MTC No. EEL. BP. 40/0664

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 (2006). 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 : 1-2 Jul. 2021

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1. Absolute Sensitivity

Reference	Unit Under Test				Tolerance
Acoustic Signal (dB)	Measured Value (dB)		Deviation	Uncertainty	Limit Class 2
	Before adjust	After adjust	(dB)	(±dB)	(±dB)
113.90	114.2	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
18.3	0.10

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

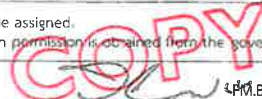
Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	16.0	0.10
C-Weighting	19.0	0.10
Flat	25.1	0.10

Date of Calibration : 1-2 Jul. 2021

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40/0664.MTC.002 Rev

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.0	0.2	0.0	0.40	2.0
1 000	0.0	-0.1	0.0	0.40	1.4
4 000	-0.9	-0.8	-0.9	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	-0.1	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	0.0	0.20	2.0
250	-0.1	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.0	0.0	0.1	0.20	3.6
8 000	0.2	0.2	0.1	0.20	5.6

Date of Calibration : 1-2 Jul. 2021

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Request No. 21-64/0618

MTC No. EEL. BP. 40/0664

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

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Request No. 21-64/0618

MTC No. EEL. BP. 40/0664

6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	88.9	-0.1	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
33	32.9	-0.1	0.30	1.4
32	31.8	-0.2	0.30	1.4
31	30.9	-0.1	0.30	1.4
30	29.8	-0.2	0.30	1.4
29	28.6	-0.4	0.30	1.4
28	27.6	-0.4	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.0	0.0	0.20	±1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 1-2 Jul. 2021

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

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FM.BL.MTC.002 Re


9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.0	-0.4	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
135.7	135.7	0.0	0.30	1.8

Calibrated by :


(Mr. Panya Phasingsri)

Approved by :


(Mr. Panya Phasingsri)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 1-2 Jul. 2021

Date of Issue : 9 Jul. 2021

Ref : 2011264060802448002

End of Certificate

8 / 8

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FM.BL.MTC.002 Re

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SOUND LEVEL METER

MODEL : NL-21

SERIAL No. : 00209071



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL. BP. 16/1164

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co.,Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi, 20230.

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 : Rion

Model : NL-21

Serial No. : 00209071 (No.15)

Microphone : Type UC-52 No.186090

Preamplifier : Type NH-21 No.00836

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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 Nov. 2021

Date of Calibration : 8-10 Nov. 2021

COPY 1/8

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL. BP. 16/1164

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 (2006). 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 : 8-10 Nov. 2021

COPY 2/8

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1. Absolute Sensitivity

Reference	Unit Under Test				Tolerance
Acoustic Signal	Measured Value (dB)		Deviation	Uncertainty	Limit Class 2
	(dB)				
	Before adjust	After adjust	(dB)	(±dB)	(±dB)
113.90	114.0	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 111.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (+dB)
18.3	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (+dB)
A-Weighting	16.3	0.10
C-Weighting	25.6	0.10
Flat	31.3	0.10

Date of Calibration : 8-10 Nov. 2021

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
125	0.4	0.5	0.4	0.40	2.0
1 000	-0.1	-0.1	0.0	0.40	1.4
4 000	0.4	0.4	0.4	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
	(dB)	(dB)	(dB)		
63	-0.1	-0.1	-0.2	0.20	2.5
125	-0.1	0.0	-0.1	0.20	2.0
250	-0.1	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.0	0.1	0.1	0.20	3.6
8 000	0.2	0.2	0.1	0.20	5.6

Date of Calibration : 8-10 Nov. 2021

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 8-10 Nov. 2021

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FM.BL.MTC.002 Rev.

6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
33	33.0	0.0	0.30	1.4
32	31.9	-0.1	0.30	1.4
31	30.9	-0.1	0.30	1.4
30	29.9	-0.1	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	28.0	0.0	0.30	1.4

Date of Calibration : 8-10 Nov. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL. BP. 16/1164

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.0	0.0	0.20	±1.3
	2	98.9	-0.1	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
SEL	200	110.0	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.8	-0.2	0.20	+1.8; -5.3

Date of Calibration : 8-10 Nov. 2021

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL. BP. 16/1164

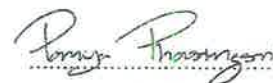
9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.0	-0.4	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
135.6	135.6	0.0	0.30	1.8

Calibrated by :



(Mr. Panya Phasingsri)



(Mr. Tawikiat Iamsamran)

Date of Calibration : 8-10 Nov. 2021

Date of Issue : 16 Nov. 2021

Approved by :



(Mr. Panya Phasingsri)



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264110504565003

End of Certificate

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CA8889

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168429



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Approved signatory
N.Smith
Electronically signed:

Dosimeter

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CA8889

Firmware version: 504

Notes: Eastern Thai Consulting 1992 Co., Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	9440020
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	2490007

Notes

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CB0644

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168440



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Approved signatory

N.Smith

Electronically signed:

Dosemeter

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CB0644

Firmware version: 504

Notes: Eastern Thai Consulting 1992 Co.,Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Test summary

Date of calibration: 14/01/22

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The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	9440020
Multimeter	Fluke	8845A	2490007

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CB0958

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168438



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Approved signatory
N.Smith
Electronically signed:

Dosemeter

Instrument Information

Manufacturer: Cirrus Research plc

Notes: Eastern Thai Consulting 1992 Co.,Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Model: CR:110A

Serial number: C80958

Firmware version: 504

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
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Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	2490007

Notes

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CB0955

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168433



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Approved signatory
N.Smith
Electronically signed:

Dosemeter

Instrument Information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CB0955

Firmware version: 504

Notes: Eastern Thai Consulting 1992 Co., Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	2490007
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	9440020

Notes

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CB0954

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168445



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Acoustic House
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United Kingdom

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Approved signatory

N.Smith

Electronically signed:

Dosemeter

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CB0954

Firmware version: 504

Notes: Eastern Thai Consulting 1992 Co.,Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	9440020
Multimeter	Fluke	8845A	2490007
Signal Generator	TTi	TGA1241	419342

Notes

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CA8888

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168425

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Acoustic House
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United Kingdom

Page 1 of 1

Approved signatory

N.Smith

Electronically signed:



Dosemeter

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CA8888

Firmware version: 504

Notes: Eastern Thai Consulting 1992 Co., Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	2490007
Multimeter	Fluke	8845A	9440020

Notes

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NOISE DOSI METER

MODEL : CR:110A

SERIAL No. : CA8879

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 14/01/22

CERTIFICATE NUMBER 168428



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United Kingdom

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Approved signatory

N.Smith

Electronically signed:

Dosemeter

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CA8879

Firmware version: 504

Notes: Eastern Thai Consulting 1992 Co.,Ltd. 683 Moo 11
Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi
20230

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	2490007
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	9440020

Notes

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Dose Meter

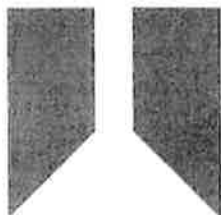
Serial No. : CB0451

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **14/01/22**

CERTIFICATE NUMBER **168439**



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United Kingdom

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Approved signatory

N.Smith

Electronically signed

Dosemeter

Instrument information

Manufacturer: **Cirrus Research plc**

Model: **CR:110A**

Serial number: **CB0451**

Firmware version: **504**

Notes: **Viridian Environmental Service Co., Ltd.**
149/119 Moo 2, Krung Non-Chong Thanom Rd.,
Mahasawat, Bang Krui, Nonthaburi 11130 Thailand

Test summary

Date of calibration: **14/01/22**

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	2490007
Multimeter	Fluke	8845A	9440020

Notes

Viridian Environmental Service Co., Ltd.

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Dose Meter

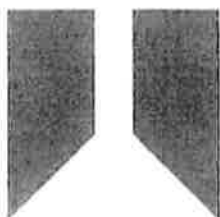
Serial No. : CB0452

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **14/01/22**

CERTIFICATE NUMBER **168443**



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YO14 0PH
United Kingdom

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Approved signatory

N.Smith

Electronically signed

Dosemeter

Instrument information

Manufacturer: **Cirrus Research plc**

Model: **CR:110A**

Serial number: **CB0452**

Firmware version: **504**

Notes: **Viridian Environmental Service Co., Ltd.**
149/119 Moo 2, Krung Non-Chong Thanom Rd.,
Mahasawat, Bang Krui, Nonthaburi 11130 Thailand

Test summary

Date of calibration: **14/01/22**

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	2490007
Multimeter	Fluke	8845A	9440020

Notes

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Dose Meter

Serial No. : CB0453

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **14/01/22**

CERTIFICATE NUMBER **168435**



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N.Smith
Electronically signed

Dosemeter

Instrument information

Manufacturer: **Cirrus Research plc**

Model: **CR:110A**

Serial number: **CB0453**

Firmware version: **504**

Notes: **Viridian Environmental Service Co., Ltd.**
149/119 Moo 2, Krung Non-Chong Thanom Rd.
Mahasawat, Bang Krui, Nonthaburi 11130 Thailand

Test summary

Date of calibration: **14/01/22**

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	2490007
Multimeter	Fluke	8845A	9440020
Signal Generator	TTi	TGA1241	419342

Notes

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Dose Meter

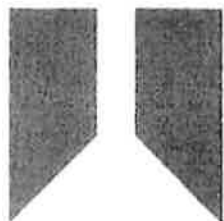
Serial No. : CB0454

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **14/01/22**

CERTIFICATE NUMBER **168436**



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United Kingdom

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Approved signatory

N.Smith

Electronically signed.

Dosemeter

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:110A

Serial number: CB0454

Firmware version: 504

Notes: Viridian Environmental Service Co., Ltd.
149/119 Moo 2, Krung Non-Chong Thanom Rd.
Mahasawat, Bang Krui, Nonthaburi 11130 Thailand

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1 2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1 2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	2490007
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	9440020

Notes

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Dose Meter

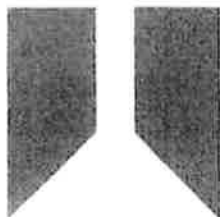
Serial No. : CB0455

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **14/01/22**

CERTIFICATE NUMBER **168444**



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United Kingdom

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Approved signatory
N.Smith
Electronically signed

Dosimeter

Instrument information

Manufacturer: Cirrus Research plc
Model: CR:110A
Serial number: CB0455
Firmware version: 504

Notes: Viridian Environmental Service Co., Ltd.
149/119 Moo 2, Krung Non-Chong Thanom Rd.
Mahasawat, Bang Krui, Nonthaburi 11130 Thailand

Test summary

Date of calibration: 14/01/22

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1 2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1 2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	9440020
Multimeter	Fluke	8845A	2490007
Signal Generator	TTi	TGA1241	419342

Notes

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Dose Meter

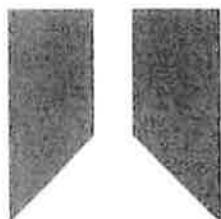
Serial No. : CB0631

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **14/01/22**

CERTIFICATE NUMBER **168437**



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United Kingdom

Page 1 of 1

Approved signatory

N.Smith

Electronically signed

Dosemeter

Instrument information

Manufacturer: **Cirrus Research plc**

Model: **CR:110A**

Serial number: **CB0631**

Firmware version: **504**

Notes: **Viridian Environmental Service Co., Ltd.**
149/119 Moo 2, Krung Non-Chong Thanom Rd.,
Mahasawat, Bang Krui, Nonthaburi 11130 Thailand

Test summary

Date of calibration: **14/01/22**

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

The dosimeter submitted for testing successfully completed the periodic tests of IEC 61252-1993+A1:2000.

The dosimeter submitted for testing conforms to the specifications in IEC 61252-1993+A1:2000.

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	2490007
Signal Generator	TTi	TGA1241	419342
Multimeter	Fluke	8845A	9440020

Notes

Viridian Environmental Service Co., Ltd.

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