

ภาคผนวก จ

เอกสารรับรองการสอบเทียบเครื่องมือตรวจวัดและเครื่องมือวิเคราะห์

List of Instrument Certificates for Environmental Quality Analysis

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* |
|-----|--------------------------|---------------------------|----------------|---------------------------|--|-------------------|---------------------|--------------------------|
| 1 | Analytical Balance | FAT OIL AND GREASE | Mettler Toledo | AB204-S/FACT / 1129361010 | Technology Promotion Association (Thailand-Japan) | 24MM292 | 11 May 24 | 10 May 25 |
| 2 | Analytical Balance | TOTAL DISSOLVED SOLIDS | Mettler Toledo | XSR205DU / C210685394 | National Food Institute,Ministry of Industry, Thailand | 2402283-002-01 | 2 Apr 24 | 1 Apr 25 |
| 3 | Analytical Balance | TOTAL SUSPENDED SOLIDS | Mettler Toledo | XSR205DU / C009071872 | National Food Institute,Ministry of Industry, Thailand | 2402283-001-01 | 2 Apr 24 | 1 Apr 25 |
| 4 | DO Meter | BIOCHEMICAL OXYGEN DEMAND | YSI | 5100 / 11B 101863 | Technology Promotion Association (Thailand-Japan) | 24TW39 | 21 Feb 24 | 20 Feb 25 |
| 5 | pH Meter | pH | Horiba | LAQUA-PH210 / HA0E0009 | technology promotion association (thailand-japan) | 24CH238 | 20 Feb 24 | 19 Feb 25 |
| 6 | UV-VIS Spectrophotometer | CHEMICAL OXYGEN DEMAND | Hitachi | U-1900 / 2021-064 | DQE Services Co.,Ltd. | SP24-008 | 16 Jan 24 | 15 Jan 25 |

Due Date of Calibration* : Based on the annual calibration plan. At least 1 time per year.

Calibration Certificate

Certificate No.: 2402283-002-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 SOI UDOMSUK 41, SUKHUMVIT ROAD,
Bangchack, Prakhong, Bangkok 10260

Page 1 of 4

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Order No.: 2402283
Operation No.: 2402283-002
Date of Receipt: 2 April 2024
Date of Calibration: 2 April 2024

Calibrated by Mr.Jerawut Prapawuttipong
Scientist
Date of Issue: 9 April 2024

Approved by
(Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

The uncertainties are for a confidence probability of approximately 95%

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 units 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 National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2402283-002-01
Equipment: Electronic Balance
Model: XSR205DU
Serial No.: C210685394
Capacity: 220 g

Manufacturer: METTLER TOLEDO
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.010/2565

Page 2 of 4

Date of Calibration: 2 April 2024
Environment Condition: Ambient Temperature: 24.5 ± 0.5 °C Relative Humidity: 47.5 ± 2.5 %
Place of Calibration: Laboratory, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019
2. Reference Standards:

| Reference Standard | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------------|-------------|---------------|----------------|-----------------|-----------------|
| Standard Weight Class E2 | 1mg to 200g | 8505567572 | TCS | M23040535 | 8 April 2024 |
| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
| Thermo-Hygro Meter | 608-H1 | NFLBTH 016/23 | Quality Reborn | QR24-0343 | 9 February 2025 |

3. This certification is traceable to SI UNIT
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.

Calibration Results:

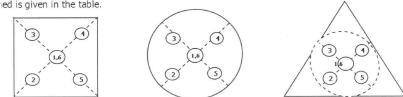
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|---------------------|-------------------------------------|
| 40 | 0.0000042 |
| 80 | 0.0000052 |
| 100 | 0.000048 |
| 200 | 0.000048 |

2. Off-Center Error:

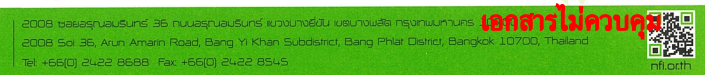
A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



| 1 (g) | 2 (g) | 3 (g) | 4 (g) | 5 (g) | 6 (g) | (Maximum Difference) (g) |
|----------|----------|---------|---------|----------|----------|----------------------------|
| 100.0000 | 100.0001 | 99.9999 | 99.9999 | 100.0001 | 100.0000 | 0.0001 |

F-CS-012 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2402283-002-01
Equipment: Electronic Balance
Model: XSR205DU
Serial No.: C210685394
Capacity: 220 g

Manufacturer: METTLER TOLEDO
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.010/2565

Page 3 of 4

Date of Calibration: 2 April 2024

Calibration Results: (Continued)

Calibration Range: 0 - 80 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 0 - 80 g ; Resolution: 0.00001 g)

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor k |
|---------------------|----------------------|-----------------------|------------------|---------------------|-------------------|
| Unload | 0.000000 | 0.00000 | 0.00000 | 0.0000086 | 2.00 |
| 0.001 | 0.001003 | 0.00101 | -0.00001 | 0.0000089 | 2.00 |
| 0.005 | 0.005003 | 0.00500 | 0.00000 | 0.0000092 | 2.00 |
| 0.01 | 0.010003 | 0.01000 | 0.00000 | 0.0000089 | 2.00 |
| 0.05 | 0.049996 | 0.05000 | 0.00000 | 0.0000096 | 2.00 |
| 0.1 | 0.100011 | 0.10000 | 0.00001 | 0.000011 | 2.00 |
| 0.5 | 0.500016 | 0.50001 | 0.00001 | 0.000014 | 2.00 |
| 1 | 1.000003 | 1.00002 | -0.00002 | 0.000016 | 2.00 |
| 2 | 2.000023 | 2.00001 | 0.00001 | 0.000017 | 2.00 |
| 5 | 5.000017 | 5.00002 | 0.00000 | 0.000020 | 2.00 |
| 10 | 10.000009 | 10.00000 | 0.00001 | 0.000026 | 2.00 |
| 20 | 20.000031 | 20.00000 | 0.00003 | 0.000037 | 2.00 |
| 30 | 30.000040 | 30.00001 | 0.00003 | 0.000050 | 2.00 |
| 50 | 50.000028 | 50.00002 | 0.00001 | 0.000068 | 2.00 |
| 80 | 80.000068 | 80.00002 | 0.00005 | 0.00011 | 2.00 |

F-CS-012 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2402283-002-01
Equipment: Electronic Balance
Model: XSR205DU
Serial No.: C210685394
Capacity: 220 g

Manufacturer: METTLER TOLEDO
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.010/2565

Page 4 of 4

Date of Calibration: 2 April 2024

Calibration Results: (Continued)

Calibration Range: 81 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 81 - 200 g ; Resolution: 0.0001 g)

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor k |
|---------------------|----------------------|-----------------------|------------------|---------------------|-------------------|
| 90 | 90.00010 | 90.0001 | 0.0000 | 0.00015 | 2.00 |
| 100 | 100.00006 | 100.0001 | 0.0000 | 0.00015 | 2.00 |
| 110 | 110.00007 | 110.0001 | 0.0000 | 0.00016 | 2.00 |
| 120 | 120.00009 | 120.0000 | 0.0001 | 0.00017 | 2.00 |
| 130 | 130.00010 | 130.0000 | 0.0001 | 0.00019 | 2.00 |
| 140 | 140.00014 | 140.0000 | 0.0001 | 0.00020 | 2.00 |
| 150 | 150.00009 | 150.0001 | 0.0000 | 0.00020 | 2.00 |
| 160 | 160.00010 | 160.0001 | 0.0000 | 0.00022 | 2.00 |
| 170 | 170.00012 | 170.0001 | 0.0000 | 0.00023 | 2.00 |
| 200 | 200.00016 | 200.0002 | 0.0000 | 0.00028 | 2.00 |

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

F-CS-012 Revision: 01 Date: 20-04-65





Cert.No.: 24CH238
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HAOE0009
ID No. : UAE.EFM.071/2564(EFM.pH.04/64)
Condition As-Received: Used Item
Received Date : 19 February 2024
Calibration Date : 20 February 2024
Reference : 2402-0594WC-2
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with
DC Voltage Standard and direct measurement
with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Walalak Sirinthean

Approved by :

() Pornthippa Tameyakul
() Unnopphol Harachai
(✓) Saitip Meangmai

Issue Date : 22 February 2024

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

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Cert.No.: 24CH238
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

| Instrument | Serial No. | ID No. | Cert. No. | Due Date |
|--------------------------------|------------|----------|-----------|--------------|
| 1) Document Process Calibrator | 54030049 | 130RC116 | 23E2802 | 27 Aug 2024 |
| 2) Ref. Standard Thermometer | 4982054 | 110RC044 | 23I908 | 26 July 2024 |

This certification is traceable to the International System of Unit maintained through:-
- Technology Promotion Association (Thailand-Japan)

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

| Buffer Solution | Manufacturer | Lot No. | Exp. date |
|-----------------|--------------|---------|-------------|
| pH 4.008 | CPA chem | 940102 | 27 Nov 2025 |
| pH 6.986 | CPA chem | 940104 | 02 Nov 2024 |
| pH 9.997 | CPA chem | 940106 | 02 Nov 2024 |

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

Calibration Results

Function : mV Measurement

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

| Unit Under Calibration | Nominal Value | Standard Voltage Input | Actual Reading | | Uncertainty of Measurement (±mV) | Coverage factor k |
|----------------------------|---------------|------------------------|----------------|-------|---------------------------------------|----------------------|
| | | | mV | pH | | |
| pH Meter S/N.: HAOE0009 | 4.00 | 177.48 | 177.4 | 4.01 | 0.058 | 2.00 |
| | 7.00 | 0.00 | 0.0 | 7.00 | 0.058 | 2.00 |
| | 7.00 | 0.00 | 0.0 | 7.00 | 0.058 | 2.00 |
| | 10.00 | -177.48 | -177.4 | 10.01 | 0.058 | 2.00 |

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Cert.No.: 24CH238
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7)(7,10)

| Unit Under Calibration | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH Measurement (±) | Coverage factor k |
|--------------------------------|-----------------------------|-------------------|------------------------|-----------------------------------|-------------------|
| pH Electrode S/N.: 992C0006 | 4.008 | 4.02 | 149.4 | 0.0086 | 2.05 |
| | 6.986 | 7.00 | -24.4 | 0.0093 | 2.00 |
| | 6.986 | 7.00 | -25.0 | 0.0093 | 2.00 |
| | 9.997 | 10.00 | -196.7 | 0.0085 | 2.00 |

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9625
- Serial No. : 992C0006

Dimension of probe

- Length : 110 mm.
- Diameter : 16 mm.
- Immersion Depth : 100 mm.

| Calibration Point (°C) | Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty of measurement (± °C) | Coverage factor k |
|------------------------|---------------------------|-------------------|------------|-----------------------------------|-------------------|
| 25.0 | 25.000 | 25.0 | 0.000 | 0.13 | 2.00 |
| 30.0 | 30.000 | 30.0 | 0.000 | 0.13 | 2.00 |
| 35.0 | 34.999 | 35.0 | 0.001 | 0.13 | 2.00 |

Remark - UUC* = Unit Under Calibrator

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

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Saitip

a 1203293



Certificate of Calibration

Cert.No.: 24MM292
Page.: 1 of 3

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : AB204-S/FACT
Serial No. : 1129361010
ID No. : UAE.WAS.002/2552
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Balance Room (108)
Received order : 11 May 2024
Calibration Date : 11 May 2024
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by : Khit Ruttanaprapachai
Approved by : Kunchit
Approved Signatory
() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 15 May 2024

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

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Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-1

Cert.No.: 24MM292
Page: 2 of 3

Procedure used :-

Calibration were conducted using in-house calibration procedure CP-OB01 based on UKAS LAB 14 according to direct measurement method against standard weight.

Condition of this result of calibration

1. Reference standard instruments:-

- | Instruments | Model | Serial No. | ID No. | Test report No. | Due date |
|-----------------------------|-------|------------|---------|-----------------|-------------|
| 1) Standard Weight Set (E2) | 15884 | 24053 | 70RC007 | MM-0013-24 | 25 Jan 2026 |
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.
4. This certificate is not certified for any commercial transaction.
5. This certification is traceable to the International System of Unit.

Result of calibration () Without Adjustment (*) After Adjustment by Internal Calibration

Range capacity : 0 g to 220 g Resolution 0.0001 g

Before Adjustment :

| Applied Weight (g) | Balance Reading (g) | Correction (g) | Measurement Uncertainty (± mg) | Coverage Factor (k) |
|-------------------------|-----------------------------|---------------------|--|-----------------------------|
| 100 | 100.0000 | 0.0000 | 0.19 | 2.03 |
| 200 | 200.0006 | -0.0006 | 0.30 | 2 |

After Adjustment :

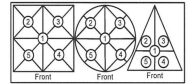
1. Determination of the standard deviation of weighing machine (n = 10)

| Applied Weight (g) | Standard Deviation of Reading (g) |
|-------------------------|--|
| 100 | 0.00007 |
| 200 | 0.00005 |



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-1

Cert.No.: 24MM292
Page: 3 of 3



Maximum difference between
off-center and central loading
(g)
0.0001

2. Effect of off center loading

A mass of 100 g was placed to various position on the pan.
The weighing machine reading error obtained is given in the table

| Position 1 (g) | Position 2 (g) | Position 3 (g) | Position 4 (g) | Position 5 (g) |
|---------------------|---------------------|---------------------|---------------------|---------------------|
| -0.0004 | -0.0004 | -0.0003 | -0.0003 | -0.0004 |

3. Departure from nominal value

| Applied Weight (g) | Balance Reading (g) | Correction (g) | Measurement Uncertainty (± mg) | Coverage Factor (k) |
|-------------------------|-----------------------------|---------------------|--|-----------------------------|
| Unload | 0.0000 | 0.0000 | 0.15 | 2.13 |
| 0.01 | 0.0100 | 0.0000 | 0.15 | 2.13 |
| 0.05 | 0.0500 | 0.0000 | 0.15 | 2.13 |
| 0.1 | 0.1000 | 0.0000 | 0.15 | 2.13 |
| 0.5 | 0.5000 | 0.0000 | 0.15 | 2.13 |
| 1 | 1.0000 | 0.0000 | 0.15 | 2.13 |
| 10 | 10.0000 | 0.0000 | 0.15 | 2.11 |
| 50 | 49.9999 | +0.0001 | 0.17 | 2.06 |
| 100 | 99.9999 | +0.0001 | 0.19 | 2.03 |
| 150 | 149.9998 | +0.0002 | 0.29 | 2 |
| 200 | 199.9990 | +0.0010 | 0.30 | 2 |

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

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เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



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

Cert.No.: 24TW39
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5100
Serial No. : 11B 101863
ID No. : UAE.WAO.004/2554
Received Date : 20 February 2024
Test Date : 21 February 2024
Reference : 2402-0629DSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirithean

Approved by :
Approved Signatory

() Pornthippa Tameyakul
() Unnopphol Harachai
(✓) Saithip Meangmai

Issue Date : 22 February 2024

เอกสารไม่ควบคุม



Cert.No.: 24TW39
Page.: 2 of 2

Condition of this result of calibration

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

| Instruments | Serial No. | ID No. | Certificate No. | Due Date |
|-------------|------------|----------|-----------------|--------------|
| 1. Burette | - | 130BU10 | 23CG1172 | 22 Mar 2025 |
| 2. Balance | 14233821 | 110RC001 | 23MM405 | 16 July 2024 |

2. Standard Material :-

| Material | Manufacturer | Lot.No. | Assay |
|---------------------------------|--------------|-----------|--------|
| Sodium Thiosulfate pentahydrate | Merck | AM1763316 | 100.2% |

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 22B100125

| Titration Method (Azide Modification Method) (mg/L) | DO Meter Reading (mg/L) | Standard Deviation (mg/L) |
|---|-------------------------------|------------------------------|
| 8.20 | 8.19 | 0.0055 |

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

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เอกสารไม่ควบคุม

Calibration Certificate

Certificate No.: 2402283-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udumuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Serial No.: C009071872
ID No.: UAE.WAO.012/2563
Order No.: 2402283
Operation No.: 2402283-001
Date of Receipt: 2 April 2024
Date of Calibration: 2 April 2024

Calibrated by Mr.Jerawut Prapawuttipong
Scientist
Approved by (Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team
Date of Issue: 9 April 2024

The uncertainties are for a confidence probability of approximately 95%

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 units 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 National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2402283-001-01
Equipment: Electronic Balance
Model: XSR205DU
Serial No.: C009071872
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.012/2563

Date of Calibration: 2 April 2024

Calibration Results: (Continued)

Calibration Range: 0 - 80 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 0 - 80 g ; Resolution: 0.00001 g)

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor k |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|----------------------|
| Unload | 0.000000 | 0.00000 | 0.00000 | 0.0000088 | 2.00 |
| 0.001 | 0.001003 | 0.00101 | -0.00001 | 0.0000091 | 2.00 |
| 0.005 | 0.005003 | 0.00499 | 0.00001 | 0.0000094 | 2.00 |
| 0.01 | 0.010003 | 0.01000 | 0.00000 | 0.0000091 | 2.00 |
| 0.05 | 0.049996 | 0.05000 | 0.00000 | 0.0000098 | 2.00 |
| 0.1 | 0.100011 | 0.10000 | 0.00001 | 0.000011 | 2.00 |
| 0.5 | 0.500016 | 0.50001 | 0.00001 | 0.000014 | 2.00 |
| 1 | 1.000003 | 1.00002 | -0.00002 | 0.000016 | 2.00 |
| 2 | 2.000023 | 2.00001 | 0.00001 | 0.000017 | 2.00 |
| 5 | 5.000017 | 5.00002 | 0.00000 | 0.000020 | 2.00 |
| 10 | 10.000009 | 10.00000 | 0.00001 | 0.000026 | 2.00 |
| 20 | 20.000031 | 20.00002 | 0.00001 | 0.000037 | 2.00 |
| 30 | 30.000040 | 30.00003 | 0.00001 | 0.000052 | 2.00 |
| 50 | 50.000028 | 50.00004 | -0.00001 | 0.000068 | 2.00 |
| 80 | 80.000068 | 80.00005 | 0.00002 | 0.00011 | 2.00 |

F-CS-012 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2402283-001-01
Equipment: Electronic Balance
Model: XSR205DU
Serial No.: C009071872
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.012/2563

Date of Calibration: 2 April 2024

Environment Condition: Ambient Temperature: 24.5 ± 0.5 °C Relative Humidity: 47.5 ± 2.5 %

Place of Calibration: Laboratory, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of This Results of Calibration: Good Condition

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

| Reference Standard | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------------|-------------|----------------|----------------|-----------------|-----------------|
| Standard Weight Class E2 | 1mg to 200g | 8505567572 | TCS | M23040535 | 8 April 2024 |
| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
| Thermo-Hygro Meter | 608-H1 | NFI.BTH 016/23 | Quality Reborn | QR24-0343 | 9 February 2025 |

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

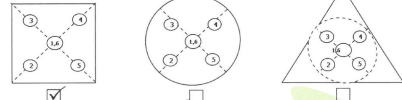
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|------------------------|--|
| 40 | 0.0000052 |
| 80 | 0.0000063 |
| 100 | 0.000048 |
| 200 | 0.000053 |

2. Off-Center Error:

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



| 1 (g) | 2 (g) | 3 (g) | 4 (g) | 5 (g) | 6 (g) | (Maximum Difference) (g) |
|------------|------------|------------|------------|------------|------------|-------------------------------|
| 100.0002 | 100.0001 | 100.0002 | 99.9999 | 100.0001 | 100.0001 | 0.0003 |

F-CS-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2402283-001-01
Equipment: Electronic Balance
Model: XSR205DU
Serial No.: C009071872
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.012/2563

Date of Calibration: 2 April 2024

Calibration Results: (Continued)

Calibration Range: 81 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 81 - 200 g ; Resolution: 0.0001 g)

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor k |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|----------------------|
| 90 | 90.000010 | 90.00000 | 0.00001 | 0.000015 | 2.00 |
| 100 | 100.000006 | 100.00000 | 0.00001 | 0.000015 | 2.00 |
| 110 | 110.000007 | 110.00001 | 0.00000 | 0.000017 | 2.00 |
| 120 | 120.000009 | 120.00000 | 0.00001 | 0.000018 | 2.00 |
| 130 | 130.000010 | 130.00000 | 0.00001 | 0.000019 | 2.00 |
| 140 | 140.000014 | 140.00000 | 0.00001 | 0.000020 | 2.00 |
| 150 | 150.000009 | 150.00001 | 0.00000 | 0.000020 | 2.00 |
| 160 | 160.000010 | 160.00001 | 0.00000 | 0.000022 | 2.00 |
| 170 | 170.000012 | 170.00001 | 0.00000 | 0.000023 | 2.00 |
| 200 | 200.000016 | 200.00000 | 0.00002 | 0.000028 | 2.00 |


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

F-CS-012 Revision: 01 Date: 20-04-65



DQEServices

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com



NSC-TB8-TB 17025
CALIBRATION 0494

CERTIFICATE OF CALIBRATION

Certificate No. : SP24-008

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

Address : 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-1900

Serial No. : 2021-064


ID No. : UAE.WAS.006/2552


Received Date : 16 January 2024

Calibration Date : 16 January 2024

Issue Date : 19 January 2024

Condition Instrument : Good

Calibrated by : 
(Mr.Tanawut Rittidach)
Technical Manager

Approved by : 
(Ms. Chonthicha Sangngern)
Quality Manager

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


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 DQE Services Co., Ltd.

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FM-708-02 R01 1/11/2021

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NSC-TB8-TB 17025
CALIBRATION 0494

REPORT OF CALIBRATION

Certificate No. : SP24-008

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

| Material | Serial No. | Certificate No. | Due date |
|-------------------------|------------|-----------------|-----------------|
| Absorbance Standard set | 25760 | 115663 | 25 October 2025 |
| Absorbance Standard set | 25757 | 115638 | 25 October 2025 |
| Wavelength Standard set | 25806 | 115657 | 25 October 2025 |
| Wavelength Standard set | 25758 | 115665 | 25 October 2025 |

Traceability : This certification is traceable to the International System of Unit maintained at National -
Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 4.0 nm.

Scan Speed of UUC : 200 nm/min

Scan Interval of UUC : 0.1 nm.


Resolution of UUC : Photometric 0.001 Abs.
Wavelength 0.1 nm.

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FM-708-02 R01 1/11/2021

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NSC-TB8-TB 17025
CALIBRATION 0494

REPORT OF CALIBRATION

Certificate No. : SP24-008

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Calibration Results : Without adjustment

Photometric Accuracy :


| Wavelength (nm.) | CRMs Values (Abs) | UUC Reading (Abs) | Correction (Abs) | Uncertainty (Abs) | Coverage factor k |
|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| 420 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5780 | 0.575 | 0.0030 | 0.0031 | 2.00 |
| | 1.0484 | 1.046 | 0.0024 | 0.0029 | 2.00 |
| | 2.1876 | 2.186 | 0.0016 | 0.0080 | 2.00 |
| 440 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5595 | 0.558 | 0.0015 | 0.0034 | 2.00 |
| | 1.0239 | 1.024 | -0.0001 | 0.0035 | 2.00 |
| | 2.1230 | 2.121 | 0.0020 | 0.0079 | 2.00 |
| 465 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5230 | 0.520 | 0.0030 | 0.0030 | 2.00 |
| | 0.9633 | 0.961 | 0.0023 | 0.0029 | 2.00 |
| | 1.9753 | 1.975 | 0.0003 | 0.0070 | 2.00 |
| 546.1 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5181 | 0.516 | 0.0021 | 0.0031 | 2.00 |
| | 1.0002 | 0.999 | 0.0012 | 0.0033 | 2.00 |
| | 1.9973 | 1.994 | 0.0033 | 0.0084 | 2.00 |
| 590 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5517 | 0.550 | 0.0017 | 0.0030 | 2.00 |
| | 1.0803 | 1.080 | 0.0003 | 0.0030 | 2.00 |
| | 2.0373 | 2.032 | 0.0053 | 0.0080 | 2.00 |
| 635 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5591 | 0.558 | 0.0011 | 0.0031 | 2.00 |
| | 1.0518 | 1.051 | 0.0008 | 0.0030 | 2.00 |
| | 1.9274 | 1.923 | 0.0044 | 0.0079 | 2.00 |

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FM-708-02 R01 1/11/2021

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NSC-TB8-TB 17025
CALIBRATION 0494

REPORT OF CALIBRATION

Certificate No. : SP24-008

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Photometric Accuracy :

| Wavelength (nm.) | CRMs Values (Abs) | UUC Reading (Abs) | Correction (Abs) | Uncertainty (Abs) | Coverage factor k |
|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| 235 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.7469 | 0.748 | -0.0011 | 0.0057 | 2.00 |
| 257 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.8674 | 0.865 | 0.0024 | 0.0059 | 2.00 |
| 313 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.2919 | 0.293 | -0.0011 | 0.0051 | 2.00 |
| 350 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.6430 | 0.641 | 0.0020 | 0.0055 | 2.00 |

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FM-708-02 R01 1/11/2021

REPORT OF CALIBRATION

Certificate No. : SP24-008

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Wavelength Accuracy :

| CRMs Values (nm.) | UUC Reading (nm.) | Correction (nm.) | Uncertainty (nm.) | Coverage factor <i>k</i> |
|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 241.54 | 241.1 | 0.44 | 0.18 | 2.00 |
| 279.40 | 278.9 | 0.50 | 0.18 | 2.00 |
| 288.70 | 288.0 | 0.70 | 0.18 | 2.00 |
| 334.22 | 333.8 | 0.42 | 0.18 | 2.00 |
| 361.26 | 360.8 | 0.46 | 0.18 | 2.00 |
| 418.48 | 418.2 | 0.28 | 0.18 | 2.00 |
| 446.70 | 446.0 | 0.70 | 0.18 | 2.00 |
| 453.20 | 453.1 | 0.10 | 0.18 | 2.00 |
| 460.06 | 459.6 | 0.46 | 0.18 | 2.00 |
| 536.90 | 536.4 | 0.50 | 0.18 | 2.00 |
| 637.94 | 637.6 | 0.34 | 0.18 | 2.00 |
| 440.74 | 440.1 | 0.64 | 0.18 | 2.00 |
| 472.22 | 472.0 | 0.22 | 0.18 | 2.00 |
| 513.70 | 513.5 | 0.20 | 0.18 | 2.00 |
| 528.72 | 528.2 | 0.52 | 0.18 | 2.00 |
| 574.60 | 574.3 | 0.30 | 0.18 | 2.00 |
| 585.48 | 585.0 | 0.48 | 0.20 | 2.00 |
| 684.63 | 684.2 | 0.43 | 0.18 | 2.00 |
| 740.27 | 740.0 | 0.27 | 0.20 | 2.00 |
| 748.28 | 747.8 | 0.48 | 0.18 | 2.00 |
| 807.16 | 806.8 | 0.36 | 0.18 | 2.00 |
| 879.70 | 879.2 | 0.50 | 0.18 | 2.00 |

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- 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%

- * Indicates non TISI accredited

- End of Certificate -

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FM-708-02 R01 1/11/2021

List of Instruments Certification for Air & Noise Quality Analysis

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration | Remark |
|----------------|--------------------------------------|---|----------------------------|------------------------|--|-------------------|---------------------|-------------------------|--------|
| Ambient | | | | | | | | | |
| 1 | Orifice Transfer Standard Calibrator | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) | Andersen Instruments, Inc. | G25A 1901 | Tisch Environmental, Inc. | 05072022 | 5 Jul 22 | 4 Jul 24 | - |
| 2 | U-Tube Manometer | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) | Dwyer | 1221-36-W/M - | Technology Promotion Association (Thailand-Japan) | 24P1251 | 11 Apr 24 | 10 Apr 25 | - |
| 3 | Air Flow Meter | Particular Matter (PM _{2.5}) | Mesa Labs | DeltaCal DC1 155895 | Innovative Instrument Co., Ltd. | 23-AFM-188 | 30 Aug 23 | 29 Aug 24 | - |
| 4 | Aneroid Barometer | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5}) | Barigo, Germany | - | Technology Promotion Association (Thailand-Japan) | 24P1367 | 22 Apr 24 | 21 Apr 25 | - |
| 5 | Dial Thermo-Hygrometer | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5}) | Barigo, Germany | - | Technology Promotion Association (Thailand-Japan) | 24H756 | 10 Apr 24 | 9 Apr 25 | - |
| 6 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i 1191503036 | UAE Consultant Co., Ltd. | 13112023 | 13 Nov 23 | 12 Nov 24 | - |
| 7 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i 1191503037 | UAE Consultant Co., Ltd. | 13112023 | 13 Nov 23 | 12 Nov 24 | - |
| 8 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i 1201497724 | UAE Consultant Co., Ltd. | 21112023 | 21 Nov 23 | 20 Nov 24 | - |
| 9 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i 1201778105 | UAE Consultant Co., Ltd. | 21112023 | 21 Nov 23 | 20 Nov 24 | - |
| 10 | Standard Gases (Mixture) | Nitrogen Dioxide | Airgas | EB0143262 2015PSIG | Airgas an Air Liquide company | E04NI99E15A01D3 | 21 Jun 21 | 21 Jun 24 | - |
| 11 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i 1201778115 | UAE Consultant Co., Ltd. | 09112023 | 9 Nov 23 | 8 Nov 24 | - |
| 12 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i 1182920012 | UAE Consultant Co., Ltd. | 03112023 | 3 Nov 23 | 2 Nov 24 | - |

List of Instruments Certification for Air & Noise Quality Analysis

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration | Remark |
|----------------|---|---|-------------------|-----------------------|---|-------------------|---------------------|-------------------------|--------|
| Ambient | | | | | | | | | |
| 13 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i 1182920015 | UAE Consultant Co.,Ltd. | 09112023 | 9 Nov 23 | 8 Nov 24 | - |
| 14 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 42i 1182920016 | UAE Consultant Co.,Ltd. | 03112023 | 3 Nov 23 | 2 Nov 24 | - |
| 15 | Standard Gases (Mixture) | Sulphur Dioxide | Airgas | EB0143262 2015PSIG | Airgas an Air Liquide company | E04NI99E15A01D3 | 21 Jun 21 | 21 Jun 24 | - |
| 16 | Wind Speed/Wind Direction | WS/WD | Scarlet Tech Ltd. | WL-21 2112DR0065 | Thai Meteorological Department | 097/24 | 22 Feb 24 | 21 Feb 25 | - |
| 17 | Sound Level Calibrator (Acoustic Calibrator) | Calibrate Sound Level Meter | Svantek | SV35A 73249 | Innovative Instrument Co.,Ltd. | 23-ACT-111 | 27 Jun 23 | 26 Jun 24 | - |
| 18 | Sound Level Meter | $L_{Aeq} 1 \text{ hr}, L_{Aeq} 24 \text{ hrs}, L_{Amax}, L_{A90}, L_{Adn}$ ระดับเสียงรบกวน | Larson Davis | LxT1 0007305 | Electrical And Electronics Institute Foundation For Industrial Development | CP20230301EA | 5 Aug 23 | 4 Aug 24 | - |
| 19 | Sound Level Meter | $L_{Aeq} 1 \text{ hr}, L_{Aeq} 24 \text{ hrs}, L_{Amax}, L_{A90}, L_{Adn}$ ระดับเสียงรบกวน | Larson Davis | LxT1 0007306 | Electrical And Electronics Institute Foundation For Industrial Development | CP20230302EA | 5 Aug 23 | 4 Aug 24 | - |
| 20 | Sound Level Meter | $L_{Aeq} 1 \text{ hr}, L_{Aeq} 24 \text{ hrs}, L_{Amax}, L_{A90}, L_{Adn}$ ระดับเสียงรบกวน | Larson Davis | LxT1 0007308 | Electrical And Electronics Institute Foundation For Industrial Development | CP20230303EA | 7 Aug 23 | 6 Aug 24 | - |
| 21 | Sound Level Meter | $L_{Aeq} 1 \text{ hr}, L_{Aeq} 24 \text{ hrs}, L_{Amax}, L_{A90}, L_{Adn}$ ระดับเสียงรบกวน | Larson Davis | LxT1 0007309 | Electrical And Electronics Institute Foundation For Industrial Development | CP20230304EA | 7 Aug 23 | 6 Aug 24 | - |
| 22 | Sound Level Meter | $L_{Aeq} 1 \text{ hr}, L_{Aeq} 24 \text{ hrs}, L_{Amax}, L_{A90}, L_{Adn}$ ระดับเสียงรบกวน | Larson Davis | LxT1 0007310 | Electrical And Electronics Institute Foundation For Industrial Development | CP20230305EA | 7 Aug 23 | 6 Aug 24 | - |
| 23 | Sound Level Meter | $L_{Aeq} 1 \text{ hr}, L_{Aeq} 24 \text{ hrs}, L_{Amax}, L_{A90}, L_{Adn}$ ระดับเสียงรบกวน | Larson Davis | LxT1 0007311 | Innovative Instrument Co.,Ltd. | 23-SLM-296 | 6 Sep 23 | 5 Sep 24 | - |

List of Instruments Certification for Air & Noise Quality Analysis

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration | Remark |
|-------|----------------------|--|---------------------------|-----------------------|--------------------------------------|-------------------|---------------------|-------------------------|--------|
| Stack | | | | | | | | | |
| 1 | Pre-Test Console | Total Suspended Particulate | Apex Instruments, USA. | XC-572-V 1701018 | Envi Equipment Service Co., Ltd. | E23-12095 | 12 Sep 23 | 11 Sep 24 | - |
| 2 | Flue gas Analyzer | Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide | Testo | Testo 350 60899617 | Entech Industrial Sulation Co., Ltd. | G 660614 | 5 Oct 23 | 4 Oct 24 | - |

List of Instruments Certification for Air & Noise Quality Analysis

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration | Remark |
|-----------|---|-----------------------------|--------------|-------------------|-----------------------------------|-------------------|---------------------|-------------------------|--------|
| Workplace | | | | | | | | | |
| 1 | Sound Level Calibrator (Acoustic Calibrator) | Calibrate Sound Level Meter | Svantek | SV36 107224 | Innovative Instrument Co.,Ltd. | 23-ACT-117 | 4 Aug 23 | 3 Aug 24 | - |
| 2 | Sound Level Meter | L_{Aeq} 8 hrs, L_{Amax} | Rion, Japan | NL-42 00558210 | Quality Calibration Co.,Ltd. | ACL23341 | 7 Nov 23 | 6 Nov 24 | - |

CERTIFICATE OF CALIBRATION

Certificate No. : COF-002-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : Andersen Instruments
MODEL/TYPE : G25A
SERIAL NUMBER : 1901
ID NUMBER : UAE.ANV.051/2547
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,
Bangkok 10260

RECEIVED DATE : 07 Jul 2023
MEASUREMENT DATE : 14 Jul 2023
ISSUE DATE : 18 Jul 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 23.9 °C and 54.5%RH.

NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:
The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IMC/W2-dp. The W1-GL-004 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$. Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM Evaluation of measurement data - Guide to the expression of uncertainty in measurement

MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The Humid air was used as a medium in the system. The standard conditions are 25°C (298.15 K) and 760 mmHg for standard temperature and standard pressure respectively.

Table 1: The results of Q Standard calibration data

| Plate | Flow rate m ³ /min | Pressure [Pa] mmHg | Temperature [Ta] °C | Temperature [Tm] °C | Δp_meter mmHg | Δp_Orifice inH ₂ O | γ | Standard Flow [Qs] m ³ /min |
|-------|----------------------------------|--------------------------|---------------------------|---------------------------|------------------|----------------------------------|-------|---|
| 1 | 0.701 | 754.115 | 23.87 | 23.10 | 55.600 | 1.626 | 1.273 | 0.648 |
| 2 | 0.997 | 754.083 | 23.80 | 23.23 | 61.350 | 3.236 | 1.795 | 0.914 |
| 3 | 1.121 | 754.005 | 23.81 | 23.20 | 41.923 | 4.338 | 2.079 | 1.057 |
| 4 | 1.172 | 754.004 | 23.72 | 23.16 | 30.933 | 4.891 | 2.208 | 1.122 |
| 5 | 1.410 | 753.994 | 23.76 | 23.18 | 29.415 | 7.159 | 2.671 | 1.352 |

Slope (m): 1.98463
Intercept (b): -0.01636
Correlation coefficient (r): 0.99972
Uncertainty (k=2): 0.015 m³/min

Table 2: The results of Q actual calibration data

| Plate | Flow rate m ³ /min | Pressure [Pa] mmHg | Temperature [Ta] °C | Temperature [Tm] °C | Δp_meter mmHg | Δp_Orifice inH ₂ O | γ | Standard Flow [Qs] m ³ /min |
|-------|----------------------------------|--------------------------|---------------------------|---------------------------|------------------|----------------------------------|-------|---|
| 1 | 0.701 | 754.115 | 23.87 | 23.10 | 55.600 | 1.626 | 0.800 | 0.651 |
| 2 | 0.997 | 754.083 | 23.80 | 23.23 | 61.350 | 3.236 | 1.129 | 0.917 |
| 3 | 1.121 | 754.005 | 23.81 | 23.20 | 41.923 | 4.338 | 1.307 | 1.061 |
| 4 | 1.172 | 754.004 | 23.72 | 23.16 | 30.933 | 4.891 | 1.388 | 1.126 |
| 5 | 1.410 | 753.994 | 23.76 | 23.18 | 29.415 | 7.159 | 1.679 | 1.357 |

Slope (m): 1.24306
Intercept (b): -0.01029
Correlation coefficient (r): 0.99972
Uncertainty (k = 2): 0.015 m³/min

End of Certificate of Calibration

Calibrated by:
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager



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เอกสารไม่ควบคุม

THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484

Certificate of Calibration

Certificate No. : 24P1251
Page : 1 of 2

Equipment : U Tube Manometer
Manufacturer: Dwyer
Model : 1221-36-W/M
Serial No.: -
ID No.: UAE.EFM.077/2566

Condition As-Received: Used Item

Received Date: 03 April 2024
Calibration Date: 11 April 2024

Reference: 2404-0118WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1012 mbar

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P04, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|------------------------|--------|------------|-----------------|-------------|
| 1) Pressure Calibrator | PC106P | 1189 | MP-0176-23 | 12 Sep 2024 |

- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is 1 kPa = 4.0146293 inH₂O
- This instrument was used clean air as pressure media.
- This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.
- This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.
- The certificate is valid only to the item calibrated on date and place of calibration.
- This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Metrology (Thailand), NSC-ONSC Accredited No, Calibration 0144

Calibrated by : Suksan Khankaew
Issue Date : 17 April 2024

Approved Signatory :
[] Phalinee Prathpalpal
[] Sura Suwannasri
[✓] Attapol Panurach

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Cert.No.: 24P1251
Page: 2 of 2

Result of calibration:- Without adjustment
Function:- Pressure Measurement
Increasing Pressure

Range : 0 inH₂O to 36 inH₂O
Scale Interval: 0.1 inH₂O (The Second Estimate)

| Applied Pressure | High-port side | UUC Indication | Low-port side | ΔP | Error |
|------------------|----------------|----------------|---------------|------|-------|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2.00 | 1.00 | -1.00 | 2.00 | 0.00 | 0.00 |
| 4.00 | 2.00 | -2.00 | 4.00 | 0.00 | 0.00 |
| 6.00 | 3.00 | -3.00 | 6.00 | 0.00 | 0.00 |
| 8.00 | 4.00 | -4.00 | 8.00 | 0.00 | 0.00 |
| 10.00 | 5.00 | -5.00 | 10.00 | 0.00 | 0.00 |
| 12.00 | 6.00 | -6.00 | 12.00 | 0.00 | 0.00 |
| 14.00 | 7.05 | -7.05 | 14.10 | 0.10 | 0.10 |
| 16.00 | 8.05 | -8.05 | 16.10 | 0.10 | 0.10 |
| 18.00 | 9.05 | -9.05 | 18.10 | 0.10 | 0.10 |
| 20.00 | 10.05 | -10.05 | 20.10 | 0.10 | 0.10 |
| 22.00 | 11.05 | -11.05 | 22.10 | 0.10 | 0.10 |
| 24.00 | 12.05 | -12.05 | 24.10 | 0.10 | 0.10 |
| 26.00 | 13.05 | -13.05 | 26.10 | 0.10 | 0.10 |
| 28.00 | 14.05 | -14.05 | 28.10 | 0.10 | 0.10 |
| 30.00 | 15.05 | -15.05 | 30.10 | 0.10 | 0.10 |
| 32.00 | 16.05 | -16.10 | 32.15 | 0.15 | 0.15 |
| 34.00 | 17.05 | -17.10 | 34.15 | 0.15 | 0.15 |
| 35.80 | 18.00 | -18.00 | 36.00 | 0.20 | 0.20 |

The uncertainty of measurement was ± 0.11 inH₂O

* ΔP = High-port side - Low-port side

* 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 of approximately 95 %.

-000-

เอกสารไม่ควบคุม

Certificate of Calibration

Customer
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

Certificate No : 23-AFM-188
Request No : Req-2023-1656

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 155895
ID : UAE.EFM.076/2560

Sensor Model : -
Sensor Serial Number : -

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 7 August 2023
Calibration Date : 30 August 2023
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 Standard flow | 19031011003 | Sensidyne | 12 July 2024 |
| Air Flow Meter | Gilibrator 3 High flow | 18501012012 | Sensidyne | 12 July 2024 |
| Temperature meter | GT 11 | 08000057 | Qreborn | 27 February 2024 |
| Pressure meter | CPG2400 | 41000KDU/651882 | TPA | 7 November 2023 |


Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

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

Calibration By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 30 August 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuer.
FM-708-AFM-01 Rev.00 Issue date 01/07/19

เอกสารไม่ควบคุม

Certificate of Calibration

Customer
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

Certificate No : 23-TPM-425
Request No : Req-2023-1656

Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 155895
Resolution : 0.1 °C
ID Number : UAE.EFM.076/2560

Range Calibration : 20 °C to 50 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 3
Calibration Position (mm) : 45
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 7 August 2023
Calibrated Date : 30 August 2023
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 27 Febuary 2023, Calibration Certificate No. : QR23-0494

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

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

Approved By : 
Mr. Noppadon Luangart
Technical Manager
Issue Date : 30 August 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuer.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

เอกสารไม่ควบคุม

Calibration Note


UUC Adjustment : Not Adjust

Certificate No : 23-TPM-425
Request No : Req-2023-1656
Page : 2/2

Result of Calibration :

| UUC Sensor | Standard Temperature (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|------------|---------------------------|------------------|-----------------|--------------------|
| Ta | 20.032 | 19.9 | + 0.1 | 0.13 |
| | 25.034 | 25.0 | 0.0 | 0.13 |
| | 30.035 | 30.0 | 0.0 | 0.13 |
| | 35.036 | 35.0 | 0.0 | 0.13 |
| | 40.038 | 40.0 | 0.0 | 0.13 |
| | 45.041 | 45.1 | - 0.1 | 0.13 |
| | 50.044 | 50.1 | - 0.1 | 0.13 |

End of Certificate

Calibrated By : 
Mr. Sitichok Jirapakdeesakul

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuer.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

เอกสารไม่ควบคุม

Certificate of Calibration

Customer
Name : UNITED ANALYST AND ENGINEERING
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong,
Bangkok 10260

Certificate No : 23-TPM-459
Request No : Req-2023-1976

Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 155895
Resolution : 0.1 °C
ID Number : UAE.EFM.076/2560

Range Calibration : 20 °C to 50 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 3
Calibration Position (mm) : 45
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 14 September 2023
Calibrated Date : 27 September 2023
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No. : QR23-0494

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

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

Approved By : 
Mr. Noppadon Luangart
Technical Manager
Issue Date : 27 September 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Calibration Lab.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

เอกสารไม่ควบคุม

Calibration Note
UUC Adjustment : Not Adjust

Certificate No : 23-TPM-459
Request No : Req-2023-1976
Page : 2/2

Result of Calibration :

| UUC Sensor | Standard Temperature (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (u °C) |
|------------|---------------------------|------------------|-----------------|--------------------|
| Tf | 20.031 | 19.8 | + 0.2 | 0.13 |
| | 25.033 | 24.8 | + 0.2 | 0.13 |
| | 30.033 | 29.9 | + 0.1 | 0.13 |
| | 35.034 | 34.9 | + 0.1 | 0.13 |
| | 40.034 | 39.8 | + 0.2 | 0.13 |
| | 45.039 | 44.8 | + 0.2 | 0.13 |
| | 50.042 | 49.8 | + 0.2 | 0.13 |

End of Certificate

Calibrated By : 
Mr. Sittichok Jirapukdeesakul

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Calibration Lab.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 24P1367
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.ANV.152/2550

Condition As-Received: Used Item
Received Date: 05 April 2024
Calibration Date: 22 April 2024

Reference: 2404-0243WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1007 mbar

Submitted by: United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|-----------------------|--------|------------|-----------------|-------------|
| 1) Standard Barometer | DPI142 | 1422505046 | MP-0094-23 | 03 May 2024 |

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.


4.This result of calibration instrument was in absolute pressure.

5.This instrument was used clean air as pressure media.

6.The certificate is valid only to the item calibrated on date and place of calibration.

7.This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew
Issue Date : 23 April 2024

Approved Signatory : 
[] Phalinee Prabpaipal
[] Sura Suwannasri
[✓] Attapol Panurach

เอกสารไม่ควบคุม



Result of calibration:- Without adjustment
Function:- Absolute Pressure Measurement

Range : 960 hPa to 1030 hPa
Scale Interval : 1 hPa (The Fifth Estimate)

| Increasing Pressure | Applied Pressure (hPa) | 957.13 | 968.77 | 980.13 | 990.56 | 1001.26 | 1011.35 | 1022.10 | 1032.61 |
|-----------------------|------------------------|--------|--------|--------|--------|---------|---------|---------|---------|
| UUC* Indication (hPa) | 960.0 | 970.0 | 980.0 | 990.0 | 1000.0 | 1010.0 | 1020.0 | 1030.0 | |
| Error (hPa) | 2.87 | 1.23 | -0.13 | -0.56 | -1.26 | -1.35 | -2.10 | -2.61 | |

| Decreasing Pressure | Applied Pressure (hPa) | 1032.61 | 1021.84 | 1010.88 | 1000.82 | 990.20 | 979.52 | 968.48 | 957.17 |
|-----------------------|------------------------|---------|---------|---------|---------|--------|--------|--------|--------|
| UUC* Indication (hPa) | 1030.0 | 1020.0 | 1010.0 | 1000.0 | 990.0 | 980.0 | 970.0 | 960.0 | |
| Error (hPa) | -2.61 | -1.84 | -0.88 | -0.82 | -0.20 | 0.48 | 1.52 | 2.83 | |

The uncertainty of measurement was ± 0.25 hPa
* 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 of approximately 95 %.

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Cert.No.: 24P1367
Page: 2 of 2

เอกสารไม่ควบคุม



Certificate of Calibration

Certificate No.: 24H756
Page: 1 of 2

Cert. No.: 24H756
Page: 2 of 2

Equipment : Dial Thermo-Hygrometer
Manufacturer: Bango
Model : -
Serial No.: -
ID No.: UAE.ANV.131/2550

Condition As-Received: Used Item

Received Date: 05 April 2024

Calibration Date: 10 April 2024
to 18 April 2024

Reference: 2404-0247WSC

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

This certificate may not be reproduced other than in full,
except with the prior written approval of the head of
Corporate Services 3: Equipment Calibration and Testing Services.

Submitted by: United Analyst and Engineering Consultant Co., Ltd.

81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 according to comparison
with standard chilled mirror sensor for humidity measurement function and comparison with standard
temperature probe for temperature measurement function into humidity / temperature chamber.

Condition of this result of calibration

1.Reference standards instruments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|-------------------------------------|------------|------------|-----------------|-------------|
| 1) Chilled Mirror Hygrometer | Dew Master | 44730 | 21656 | 02 Aug 2024 |
| 2) Handheld Thermometer With Sensor | 1521 | A5A339 | 231238 | 16 Oct 2024 |

2.The certificate is valid only to the item calibrated on date and place of calibration.

3.This Certification is traceable to the International System of Unit maintained through:-

-Thunder Scientific Corporation, NVLAB Accreditation No. Calibration 200582-0

-Technology Promotion Association (Thailand-Japan), NSC-ONS Accredited No. Calibration 0008

Calibrated by : Chakrit Waewwanjua
Issue Date : 18 April 2024

Approved Signatory :
[] Chakrit Waewwanjua
[✓] Vipom Tantiyawutti
[] Unnopphol Harachai

เอกสารไม่ควบคุม

Result of Calibration:- Without Adjustment
Function: Humidity Measurement.

| Reference Temperature (°C) | Standard Humidity (%R.H.) | UUC* Reading (%R.H.) | Error (%R.H.) | Uncertainty of Measurement (±%R.H.) |
|-------------------------------|------------------------------|----------------------------|------------------|---|
| 25.0 | 40.1 | 44 | 3.9 | 1.6 |
| 25.0 | 60.0 | 61 | 1.0 | 1.7 |
| 25.0 | 80.0 | 76 | -4.0 | 1.8 |

Result of Calibration:- Without Adjustment
Function: Temperature Measurement.

| Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty of Measurement (±°C) |
|------------------------------|-------------------------|---------------|--|
| 20.007 | 20.5 | 0.493 | 0.72 |
| 25.032 | 25.0 | -0.032 | 0.72 |
| 29.997 | 30.0 | 0.003 | 0.72 |
| 35.010 | 34.5 | -0.510 | 0.72 |
| 40.019 | 39.5 | -0.519 | 0.72 |

UUC* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied
by coverage factor k = 2.00, providing confidence level approximately 95%.

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United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Tel. 0 2763 2828 Fax 0 2763 2800 www.uaiconsultant.com E-mail: uae@uaiconsultant.com



United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Tel. 0 2763 2828 Fax 0 2763 2800 www.uaiconsultant.com E-mail: uae@uaiconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Nov 13, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1191503036

Standard Gas Concentration

| | | | | |
|------------------------------------|--------------|-----|-----------------|-------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : | Thermo Scientific |
| Nitric Oxide (NO) | 45.94 | PPM | Model : | 146i |
| Methane (CH ₄) | - | PPM | Serial Number : | 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | | |
| Cylinder No. : | EB0143262 | | | |
| Expiration Date : | Jun 21, 2024 | | | |

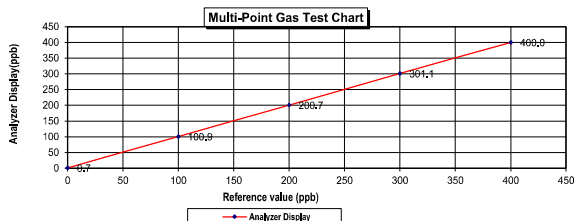
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo Scientific |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Level | Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|--------------------------|-----------------------|------------------------|------------------------|---------------|-----------|
| Level 1 | Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 | 20.00% | 100.0 | 100.9 | 0.90 | 0.89 |
| Level 3 | 40.00% | 200.0 | 200.7 | 0.70 | 0.35 |
| Level 4 | 60.00% | 300.0 | 301.1 | 1.10 | 0.37 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | 500.0 ppb | | Average Difference (%) | | 0.46 |

:Acceptable Limit ± 5%



Calculate by

13 Nov 2023

Approve by

13 Nov 2023

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Nov 13, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1191503037

Standard Gas Concentration

| | | | | |
|------------------------------------|--------------|-----|-----------------|-------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : | Thermo Scientific |
| Nitric Oxide (NO) | 45.94 | PPM | Model : | 146i |
| Methane (CH ₄) | - | PPM | Serial Number : | 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | | |
| Cylinder No. : | EB0143262 | | | |
| Expiration Date : | Jun 21, 2024 | | | |

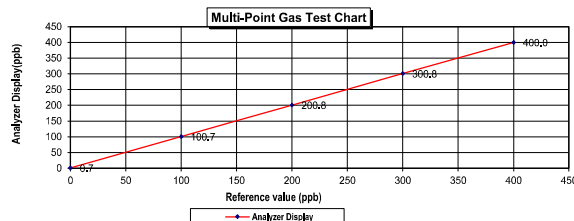
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo Scientific |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Level | Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|--------------------------|-----------------------|------------------------|------------------------|---------------|-----------|
| Level 1 | Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 | 20.00% | 100.0 | 100.7 | 0.70 | 0.70 |
| Level 3 | 40.00% | 200.0 | 200.8 | 0.80 | 0.40 |
| Level 4 | 60.00% | 300.0 | 300.8 | 0.80 | 0.27 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | 500.0 ppb | | Average Difference (%) | | 0.41 |

:Acceptable Limit ± 5%



Calculate by

13 Nov 2023

Approve by

13 Nov 2023

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Nov 21, 2023

Equipment : Gas Analyzer (NO₂) **Model** : 42i
Manufacturer : Thermo Scientific **Serial Number** : 1201497724

| Standard Gas Concentration | | Dilutor Detail | |
|------------------------------------|--------------|----------------|----------------------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : Thermo Scientific |
| Nitric Oxide (NO) | 45.94 | PPM | Model : 146i |
| Methane (CH ₄) | - | PPM | Serial Number : 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | |
| Cylinder No. : | EB0143262 | | |
| Expiration Date : | Jun 21, 2024 | | |

Multi-point gas test data

| Level | Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|----------------------------|-----------------------|------------------------|------------------|------------------------|-----------|
| Level 1 | Zero | 0.0 | 0.8 | 0.80 | 0.80 |
| Level 2 | 20.00% | 100.0 | 101.0 | 0.99 | 0.99 |
| Level 3 | 40.00% | 200.0 | 200.7 | 0.35 | 0.35 |
| Level 4 | 60.00% | 300.0 | 300.8 | 0.27 | 0.27 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | 0.48 |
| :Acceptable Limit \pm 5% | | | | | |

Multi-Point Gas Test Chart

Calculate by *Sirichai S.* Approve by *Pichan A.*
21 Nov 2023 22 Nov 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 21, 2023

Equipment : Gas Analyzer (NO₂) **Model** : 42i
Manufacturer : Thermo Scientific **Serial Number** : 1201778105

| Standard Gas Concentration | | Dilutor Detail | |
|------------------------------------|--------------|----------------|----------------------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : Thermo Scientific |
| Nitric Oxide (NO) | 45.94 | PPM | Model : 146i |
| Methane (CH ₄) | - | PPM | Serial Number : 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | |
| Cylinder No. : | EB0143262 | | |
| Expiration Date : | Jun 21, 2024 | | |

Multi-point gas test data

| Level | Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|----------------------------|-----------------------|------------------------|------------------|------------------------|-----------|
| Level 1 | Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 | 20.00% | 100.0 | 100.6 | 0.60 | 0.60 |
| Level 3 | 40.00% | 200.0 | 200.8 | 0.40 | 0.40 |
| Level 4 | 60.00% | 300.0 | 300.9 | 0.30 | 0.30 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | 0.40 |
| :Acceptable Limit \pm 5% | | | | | |

Multi-Point Gas Test Chart

Calculate by *Sirichai S.* Approve by *Pichan A.*
21 Nov 2023 22 Nov 2023

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO₂,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/831, 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.

| Component | Requested Concentration | Actual Concentration | Protocol Method | Total Relative Uncertainty | Assay Dates |
|-----------------|-------------------------|----------------------|-----------------|----------------------------|------------------------|
| NOX | 45.00 PPM | 45.96 PPM | G1 | +/- 1.4% NIST Traceable | 08/14/2021, 09/21/2021 |
| NITRIC OXIDE | 45.00 PPM | 45.94 PPM | G1 | +/- 1.4% NIST Traceable | 08/14/2021, 09/21/2021 |
| SULFUR DIOXIDE | 45.00 PPM | 44.96 PPM | G1 | +/- 1.0% NIST Traceable | 08/14/2021, 09/21/2021 |
| CARBON MONOXIDE | 1000 PPM | 984.8 PPM | G1 | +/- 0.7% NIST Traceable | 08/14/2021 |
| NITROGEN | Balance | | | | |

| Type | Lot ID | Cylinder No | Concentration | Uncertainty | Expiration Date |
|------|--------------|-------------|-------------------------------------|-------------|-----------------|
| NTRM | 20051120 | CC708098 | 49.82 PPM NITRIC OXIDE/NITROGEN | +/- 1.0% | Feb 02, 2025 |
| PRM | 12386 | D585025 | 9.91 PPM NITROGEN DIOXIDE/AIR | +/- 2.0% | Feb 20, 2020 |
| GMIS | 401423838102 | CC505581 | 4.348 PPM NITROGEN DIOXIDE/NITROGEN | +/- 2.1 | Feb 18, 2023 |
| NTRM | 16011043 | CC473277 | 46.02 PPM SULFUR DIOXIDE/NITROGEN | +/- 0.8% | Jun 17, 2022 |
| NTRM | 14060119 | CC434277 | 990.9 PPM CARBON MONOXIDE/NITROGEN | +/- 0.6% | Nov 15, 2025 |

| Instrument/Make/Model | Analytical Principle | Last Multipoint Calibration |
|---|----------------------|-----------------------------|
| Nicolet 6700 AHR0801333 CO | FTIR | Jun 03, 2021 |
| Nicolet 6700 AHR0801333 NO | FTIR | Jun 03, 2021 |
| Nicolet 6700 AHR0801333 NO ₂ | FTIR | Jun 03, 2021 |
| Nicolet 6700 AHR0801333 SO ₂ | FTIR | Jun 03, 2021 |

Triad Data Available Upon Request

NOTES: PO #5221002807
GROSS WT: 28.40kg
NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

Approved for Release



MULTI-POINT GAS TEST REPORT

Test Date : Nov 9, 2023

Equipment : Gas Analyzer (SO₂) **Model** : 43i
Manufacturer : Thermo SCIENTIFIC **Serial Number** : 1201778115

| Standard Gas Concentration | | Dilutor Detail | |
|------------------------------------|--------------|----------------|----------------------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : Thermo SCIENTIFIC |
| Nitric Oxide (NO) | 45.94 | PPM | Model : 146i |
| Methane (CH ₄) | - | PPM | Serial Number : 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | |
| Cylinder No. : | EB0143262 | | |
| Expiration Date : | Jun 24, 2024 | | |

Multi-point gas test data

| Level | Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|----------------------------|-----------------------|------------------------|------------------|------------------------|-----------|
| Level 1 | Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 | 20.00% | 100.0 | 100.6 | 0.60 | 0.60 |
| Level 3 | 40.00% | 200.0 | 200.8 | 0.40 | 0.40 |
| Level 4 | 60.00% | 300.0 | 300.9 | 0.30 | 0.30 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | 0.40 |
| :Acceptable Limit \pm 5% | | | | | |

Multi-Point Gas Test Chart

Calculate by *Sirichai S.* Approve by *Pichan A.*
9 Nov 2023 9 Nov 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 3, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920012

Standard Gas Concentration

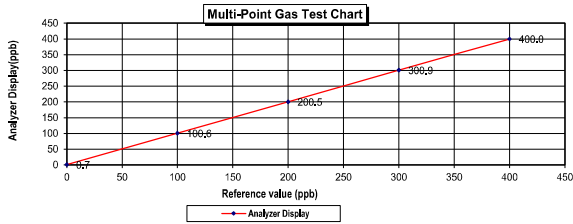
| | | | | |
|------------------------------------|--------------|-----|-----------------|-------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : | Thermo SCIENTIFIC |
| Nitric Oxide (NO) | 45.94 | PPM | Model : | 146i |
| Methane (CH ₄) | - | PPM | Serial Number : | 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | | |
| Cylinder No. : | EB0143262 | | | |
| Expiration Date : | Jun 24, 2024 | | | |

Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|-----------------------------|------------------------|------------------------|---------------|-----------|
| Level 1 Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 20.00% | 100.0 | 100.6 | 0.60 | 0.60 |
| Level 3 40.00% | 200.0 | 200.5 | 0.25 | 0.25 |
| Level 4 60.00% | 300.0 | 300.9 | 0.30 | 0.30 |
| Level 5 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | 500.0 ppb | Average Difference (%) | 0.37 | |
| :Acceptable Limit $\pm 5\%$ | | | | |



Calculate by

03 / Nov / 2023

Approve by

03 / Nov / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 9, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920015

Standard Gas Concentration

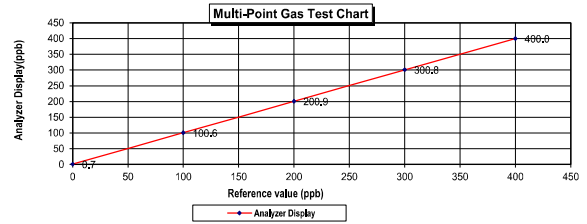
| | | | | |
|------------------------------------|--------------|-----|-----------------|-------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : | Thermo SCIENTIFIC |
| Nitric Oxide (NO) | 45.94 | PPM | Model : | 146i |
| Methane (CH ₄) | - | PPM | Serial Number : | 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | | |
| Cylinder No. : | EB0143262 | | | |
| Expiration Date : | Jun 24, 2024 | | | |

Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|-----------------------------|------------------------|------------------------|---------------|-----------|
| Level 1 Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 20.00% | 100.0 | 100.6 | 0.60 | 0.60 |
| Level 3 40.00% | 200.0 | 200.9 | 0.45 | 0.45 |
| Level 4 60.00% | 300.0 | 300.8 | 0.27 | 0.27 |
| Level 5 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | 500.0 ppb | Average Difference (%) | 0.40 | |
| :Acceptable Limit $\pm 5\%$ | | | | |



Calculate by

9 / Nov / 2023

Approve by

9 / Nov / 2023

MULTI-POINT GAS TEST REPORT

Test Date : Nov 3, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920016

Standard Gas Concentration

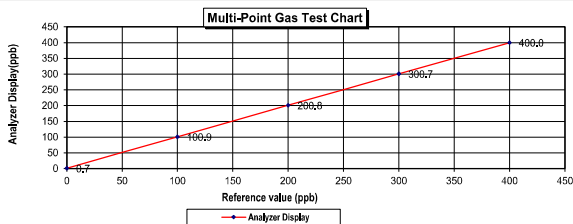
| | | | | |
|------------------------------------|--------------|-----|-----------------|-------------------|
| Sulphur Dioxide (SO ₂) | 44.68 | PPM | Manufacturer : | Thermo SCIENTIFIC |
| Nitric Oxide (NO) | 45.94 | PPM | Model : | 146i |
| Methane (CH ₄) | - | PPM | Serial Number : | 1180540071 |
| Carbon Monoxide (CO) | 984.8 | | | |
| Cylinder No. : | EB0143262 | | | |
| Expiration Date : | Jun 24, 2024 | | | |

Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Reference Value (ppb) | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|-----------------------------|------------------------|------------------------|---------------|-----------|
| Level 1 Zero | 0.0 | 0.7 | 0.70 | 0.70 |
| Level 2 20.00% | 100.0 | 100.9 | 0.90 | 0.89 |
| Level 3 40.00% | 200.0 | 200.8 | 0.40 | 0.40 |
| Level 4 60.00% | 300.0 | 300.7 | 0.23 | 0.23 |
| Level 5 80.00% | 400.0 | 400.0 | 0.00 | 0.00 |
| Remark : Measuring Range | 500.0 ppb | Average Difference (%) | 0.44 | |
| :Acceptable Limit $\pm 5\%$ | | | | |



Calculate by

03 / Nov / 2023

Approve by

03 / Nov / 2023



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 22 February, 2024

Certification No. 097/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2112DR0065

Wind Sensor 2112DT0065

Customer : United Analyst and Engineering Consultant Co., Ltd.

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.8 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119 : HOOK GAGE NO 1425

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 1206295586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

: Digital Barometer Vaisala Type PTB320 No. K4320001

Calibrated by : Natsopad

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pisod Promsut

(Authorised Signatory)

for the Chief

Sub-Standard Instrument



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 2 of 5

| Standard Ultrasonic Anemometer | HOOK GAGE NO. 1425 | | | TESTED ANEMOMETER | |
|-----------------------------------|--------------------|------------|------------|-------------------|------------|
| | Pressure | Vacuum | Velocity | Velocity | Correction |
| | m/sec | inches H2O | inches H2O | m/sec | m/sec |
| 1.00 | - | - | - | 1.0 | 0.00 |
| 3.02 | - | - | - | 2.9 | 0.12 |
| 5.00 | - | - | - | 4.9 | 0.10 |
| 7.04 | - | - | - | 7.0 | 0.04 |
| 9.02 | - | - | - | 9.0 | 0.02 |
| 11.02 | - | - | - | 11.0 | 0.02 |
| 13.01 | - | - | - | 13.0 | 0.01 |
| 15.01 | - | - | - | 15.0 | 0.01 |
| 17.02 | - | - | - | 17.0 | 0.02 |
| 20.02 | - | - | - | 20.0 | 0.02 |

| Wind Aloft Plotting Board. | |
|--|-----------------------|
| US.DEPARTMENT OF COMMERCE WEATHER BUREAU | |
| WIND DIRECTION | TESTED WIND DIRECTION |
| 0 | 0 |
| 90 | 90 |
| 180 | 180 |
| 270 | 270 |

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 3 of 5

| Standard Barometer | Tested Barometer | Correction |
|--------------------|------------------|------------|
| Pressure | Pressure | mbar |
| 1010.84 | 1011 | -0.16 |
| 1010.60 | 1011 | -0.40 |
| 1011.71 | 1011 | 0.71 |
| 1012.17 | 1012 | 0.17 |
| 1012.31 | 1012 | 0.31 |
| 1012.25 | 1012 | 0.25 |
| 1012.79 | 1013 | -0.21 |
| 1012.95 | 1012 | 0.95 |
| 1013.52 | 1014 | -0.48 |
| 1014.16 | 1014 | 0.16 |
| 1015.79 | 1016 | -0.21 |
| 1016.02 | 1016 | 0.02 |
| 1015.86 | 1016 | -0.14 |
| 1015.69 | 1015 | 0.69 |
| 1011.51 | 1012 | -0.49 |
| 1011.80 | 1012 | -0.20 |
| 1012.06 | 1012 | 0.06 |
| 1012.81 | 1013 | -0.19 |
| 1013.22 | 1013 | 0.22 |
| 1013.49 | 1014 | -0.51 |

Average 0.03

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 4 of 5

| Standard Barometer | Tested Barometer | Correction |
|--------------------|------------------|------------|
| Pressure | Pressure | mmHg |
| 758.19 | 758 | 0.19 |
| 758.01 | 758 | 0.01 |
| 758.84 | 758 | 0.84 |
| 759.19 | 759 | 0.19 |
| 759.29 | 759 | 0.29 |
| 759.25 | 759 | 0.25 |
| 759.65 | 759 | 0.65 |
| 759.77 | 760 | -0.23 |
| 760.20 | 760 | 0.20 |
| 760.68 | 760 | 0.68 |
| 761.90 | 762 | -0.10 |
| 762.08 | 762 | 0.08 |
| 761.96 | 762 | -0.04 |
| 761.83 | 762 | -0.17 |
| 758.69 | 759 | -0.31 |
| 758.91 | 759 | -0.09 |
| 759.11 | 759 | 0.11 |
| 759.67 | 760 | -0.33 |
| 759.98 | 760 | -0.02 |
| 760.18 | 760 | 0.18 |

Average 0.12

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 5 of 5

| Standard Temp. | Temperature Sensor Reading | |
|-------------------|----------------------------|------------|
| | Reading | Correction |
| °C | °C | °C |
| 45.2 | 45 | 0.2 |
| 30.3 | 30 | 0.3 |
| 15.8 | 16 | -0.2 |

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



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Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING
CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Prakanong, Bangkok 10260

Certificate No : 23-ACT-111
Request No : Req-2023-1408

Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1
Manufacturer : SVANTEK Range : 94 , 114 dB / 1000 Hz
Model : SV 35A Instrument Status : Used
Serial Number : 73249
ID : UAE.EFM.105/2561

Calibration Environment and Details


Temperature : (23 ±2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ±10.0 hPa)
Received Date : 26 June 2023
Calibration Date : 27 June 2023
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


| Reference Standard | Model | Serial Number | Traceable | Due Calibration |
|--------------------|--------|---------------|-----------|-----------------|
| Sound Calibrator | SV 35A | 58079 | EEL | 31 May 2024 |
| THD Multimeter | 2015 | 1047765 | NIMT | 31 January 2024 |

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 %.

Calibrated By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 27 June 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing laboratory.
เอกสารไม่ควบคุม
FM-708-ACT-02 Rev.00 Issue date 01/07/19

Certificate No : 23-ACT-111

Request No : Req-2023-1408

Sound pressure level

Calibration Results : Without Adjustment

| Calibration Range (dB) | Without Adjustment (dB) | | Adjustment (dB) | | Uncertainty (± dB) | Acceptance limit Class 1 (± dB) |
|---------------------------|-------------------------|-------|-----------------|-------|-----------------------|------------------------------------|
| | Measured | Error | Measured | Error | | |
| 94 dB / 1000 Hz | 93.84 | -0.16 | - | - | 0.14 | 0.25 |
| 114 dB / 1000 Hz | 113.79 | -0.21 | - | - | 0.13 | 0.25 |

Frequency of Sound pressure level

| Calibration Range (Hz) | Without Adjustment | | Adjustment | | Uncertainty (± %) | Acceptance limit Class 1 (± %) |
|---------------------------|--------------------|-----------|---------------|-----------|----------------------|-----------------------------------|
| | Measured (Hz) | Error (%) | Measured (Hz) | Error (%) | | |
| 94 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 0.70 |
| 114 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 0.70 |

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

| Calibration Range (Hz) | Without Adjustment | | Adjustment | | Uncertainty (± %) | Acceptance limit Class 1 (± %) |
|---------------------------|--------------------|-----------|--------------|-----------|----------------------|-----------------------------------|
| | Measured (%) | Error (%) | Measured (%) | Error (%) | | |
| 94 dB / 1000 Hz | 0.17 | - | - | - | 0.40 | 2.5 |
| 114 dB / 1000 Hz | 0.04 | - | - | - | 0.40 | 2.5 |

Note :

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the calibrator pressure correction
- The calibration results exclude the microphone volume correction

End of Calibration

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the issuing laboratory.
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FM-708-ACT-02 Rev.00 Issue date 01/07/19



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



Certificate No.: CP20230301EA
Operation No.: CP2023070038

Certificate of Calibration

Equipment: Sound Level Meter
Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)
Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)
Serial No.: 0007305 (Meter), 345234 (Microphone), 077640 (Preamplifier)
ID No.: UAE.EFM.038/2566
Customer: United Analyst and Engineering Consultant Co.,Ltd.
Address: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak
Phrakhanong, Bangkok 10260
Received Date: 24 July 2023
Calibrated Date: 5 - 8 August 2023
Issued Date: 9 August 2023
Calibrated by: Ms. Juntaporn Kunhakom

Approved by: 
(Mr. Sittichai Swaksuriyawong)
Group Manager

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

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



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230301EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)
Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)
Serial No.: 0007305 (Meter), 345234 (Microphone), 077640 (Preamplifier)
ID No.: UAE.EFM.038/2566
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|--|---------|------------|------------------------------|--------------------------------------|
| 1) Standard microphone | 4180 | 2787490 | AA-1024-22 | 6 November 2023 |
| 2) Arbitrary Function Generator | AFG2021 | C010063 | CK20230040EA | 26 June 2024 |
| 3) Programmable Attenuator | PA5 | 2755 | EF-0034-22 | 30 October 2023 |
| 4) 6.5 Digit precision multimeter | 8846A | 9610014 | CB20220223EA | 14 November 2023 |
| 5) Pressure humidity and Temperature Transmitter | PTU301 | F0640002 | CL1-P230024 CD20230196EA | 20 March 2024 23 July 2024 |
| 6) Pressure humidity and Temperature Transmitter | PTU301 | F0640003 | CL1-P230032 CD20230197EA | 4 April 2024 23 July 2024 |
| 7) Performance Audio Analyzer | U8903B | MY56510003 | CB20230038EA CK20220080EA | 14 February 2024 8 September 2023 |

2. This result of calibration was found accurate as shown on date and place of calibration only.
3. This certification is traceable to the international system of unit maintained at :-

- Reference standards instrument for Acoustic function
- National Institute of Metrology (Thailand)
- Reference standards instrument for Electrical function
- National Institute of Metrology (Thailand)
- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|-----------------------------------|------------------------|-------------------|---------------------------|
| 113.9 | 113.9 | 0.0 | ±0.7 |

Note : Absolute sensitivity was established by the use of the Sound Calibrator Larson Davis Type CAL200 S/N : 21091.

Certificate No.: CP20230301EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone installed

| Measured value (dB) |
|------------------------|
| 29.3 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|------------------------|------------------------|
| A-weighting | 29.0 |
| C-weighting | 28.9 |
| Z-weighting | 34.4 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.3 | 0.2 | 0.2 | ±1.0 |
| 1000 | 0.1 | 0.1 | 0.1 | ±0.7 |
| 8000 | -0.1 | 0.1 | 0.0 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.1 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | -0.1 | -0.1 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.1 | -0.1 | +2.5; -16.0 |

Page 3 of 6

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F-CAL-005 Ed.1

Certificate No.: CP20230301EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|------------------------|------------------------|---------------------------|
| C-weighting | 114.0 | 0.0 | ±0.2 |
| A-weighting | 114.0 | 0.0 | ±0.2 |
| Z-weighting | 114.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|------------------------|------------------------|---------------------------|
| Fast | 114.0 | 0.0 | ±0.1 |
| Slow | 114.0 | 0.0 | ±0.1 |
| Laeq | 114.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|--------------------------|--|------------------------|---------------------------|
| 30 | 114.0 | 114.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 139.0 | 139.1 | 0.1 | ±0.8 |
| 140.0 | 140.1 | 0.1 | ±0.8 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230301EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.2 | 0.2 | ±0.8 |
| 39.0 | 39.4 | 0.4 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|---------------------------------|------------------------|------------------------|---------------------------|
| Fast | 200 | 135.9 | -0.1 | ±0.5 |
| | 2 | 118.8 | -0.2 | +1.0; -1.5 |
| | 0.25 | 109.7 | -0.3 | +1.0; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0; -3.0 |
| | 200 | 130.0 | 0.0 | ±0.5 |
| LAE | 2 | 109.9 | -0.1 | +1.0; -1.5 |
| | 0.25 | 100.9 | -0.1 | +1.0; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------------------|---------------------------|------------------------|------------------------|---------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230301EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|----------------------------|----------------------------|------------------------|---------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 142.8 | 142.8 | 0.0 | ±1.5 |

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|-----------------------|--|------------------------|---------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 1.
3. The coverage factor $k = 2.00$

-- End of Report --

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37,
Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280

Tel: +66 2709 4860 Fax: +66 2324 0917



Certificate No.: CP20230302EA
Operation No.: CP2023070039

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007306 (Meter), 345235 (Microphone), 077641 (Preamplifier)

ID No.: UAE.EFM.039/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udumsuk 41, Sukhumvit Road, Bangchak
Phrakhanong, Bangkok 10260

Received Date: 24 July 2023

Calibrated Date: 5 - 8 August 2023

Issued Date: 9 August 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: 
(Mr. Sittichai Swaksuriyawong)
Group Manager

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

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

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F-CAL-004 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230302EA

Calibration Report

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007306 (Meter), 345235 (Microphone), 077641 (Preamplifier)

ID No.: UAE.EFM.039/2566

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|--|---------|------------|------------------------------|--------------------------------------|
| 1) Standard microphone | 4180 | 2787490 | AA-1024-22 | 6 November 2023 |
| 2) Arbitrary Function Generator | AFG2021 | C010063 | CK20230040EA | 26 June 2024 |
| 3) Programmable Attenuator | PA5 | 2755 | EF-0034-22 | 30 October 2023 |
| 4) 6.5 Digit precision multimeter | 8846A | 9610014 | CB20220223EA | 14 November 2023 |
| 5) Pressure humidity and Temperature Transmitter | PTU301 | F0640002 | CL1-P230024 CD20230196EA | 20 March 2024 23 July 2024 |
| 6) Pressure humidity and Temperature Transmitter | PTU301 | F0640003 | CL1-P230032 CD20230197EA | 4 April 2024 23 July 2024 |
| 7) Performance Audio Analyzer | U8903B | MY56510003 | CB20230038EA CK20220080EA | 14 February 2024 8 September 2023 |

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|-----------------------------------|------------------------|-------------------|---------------------------|
| 113.9 | 113.9 | 0.0 | ±0.7 |

Note : Absolute sensitivity was established by the use of the Sound Calibrator Larson Davis Type CAL200 S/N : 21091.

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F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230302EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

| Measured value (dB) |
|------------------------|
| 28.8 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|------------------------|------------------------|
| A-weighting | 28.5 |
| C-weighting | 28.3 |
| Z-weighting | 34.0 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.4 | 0.3 | 0.4 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 8000 | -0.3 | -0.3 | -0.2 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 125 | 0.0 | -0.1 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | -0.1 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | -0.1 | -0.1 | 0.0 | ±1.0 |
| 8000 | -0.1 | -0.1 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.0 | -0.1 | +2.5; -16.0 |

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F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230302EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|------------------------|------------------------|---------------------------|
| C-weighting | 114.0 | 0.0 | ±0.2 |
| A-weighting | 114.0 | 0.0 | ±0.2 |
| Z-weighting | 114.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|------------------------|------------------------|---------------------------|
| Fast | 114.0 | 0.0 | ±0.1 |
| Slow | 114.0 | 0.0 | ±0.1 |
| LAeq | 114.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|--------------------------|--|------------------------|---------------------------|
| 30 | 114.0 | 114.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 139.0 | 139.0 | 0.0 | ±0.8 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230302EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.4 | 0.4 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|------------------------------|---------------------|---------------------|------------------------|
| Fast | 200 | 136.0 | 0.0 | ±0.5 |
| | 2 | 118.8 | -0.2 | +1.0 ; -1.5 |
| | 0.25 | 109.7 | -0.3 | +1.0 ; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0 ; -3.0 |
| | 200 | 130.0 | 0.0 | ±0.5 |
| LAE | 2 | 110.0 | 0.0 | +1.0 ; -1.5 |
| | 0.25 | 100.9 | -0.1 | +1.0 ; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------------|------------------------|---------------------|---------------------|------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230302EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 142.4 | 142.4 | 0.0 | ±1.5 |

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-----------------------------------|--------------------|--|---------------------|------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 1.
3. The coverage factor $k = 2.00$

-- End of Report --

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1Certificate No.: CP20230303EA
Operation No.: CP2023070040

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRLxT1 (Preamplifier)

Serial No.: 0007308 (Meter), 345238 (Microphone), 077643 (Preamplifier)

ID No.: UAE.EFM.040/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udumsuk 41, Sukhumvit Road, Bangchak Phrakhanong, Bangkok 10260

Received Date: 24 July 2023

Calibrated Date: 7 - 9 August 2023

Issued Date: 10 August 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: 
(Mr. Sittichai Swaksuriyawong)
Group Manager

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

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

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เอกสารไม่ควบคุม
F-CAL-004 Ed.1

Certificate No.: CP20230303EA

Calibration Report

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRLxT1 (Preamplifier)

Serial No.: 0007308 (Meter), 345238 (Microphone), 077643 (Preamplifier)

ID No.: UAE.EFM.040/2566

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|--|---------|------------|------------------------------|--------------------------------------|
| 1) Standard microphone | 4180 | 2787490 | AA-1024-22 | 6 November 2023 |
| 2) Arbitrary Function Generator | AFG2021 | C010063 | CK20230040EA | 26 June 2024 |
| 3) Programmable Attenuator | PA5 | 2755 | EF-0034-22 | 30 October 2023 |
| 4) 6.5 Digit precision multimeter | 8846A | 9610014 | CB20220223EA | 14 November 2023 |
| 5) Pressure humidity and Temperature Transmitter | PTU301 | F0640002 | CL1-P230024 CD20230196EA | 20 March 2024 23 July 2024 |
| 6) Pressure humidity and Temperature Transmitter | PTU301 | F0640003 | CL1-P230032 CD20230197EA | 4 April 2024 23 July 2024 |
| 7) Performance Audio Analyzer | U8903B | MY56510003 | CB20230038EA CK20220080EA | 14 February 2024 8 September 2023 |

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)
- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|--------------------------------|---------------------|----------------|------------------------|
| 113.9 | 113.9 | 0.0 | ±0.7 |

Note : Absolute sensitivity was established by the use of the Sound Calibrator Larson Davis Type CAL200 S/N : 21091.

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230303EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

| Measured value (dB) |
|------------------------|
| 29.3 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|------------------------|------------------------|
| A-weighting | 28.6 |
| C-weighting | 28.6 |
| Z-weighting | 34.6 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.3 | 0.2 | 0.3 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 8000 | -0.7 | -0.7 | -0.6 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | -0.1 | 0.0 | ±1.0 |
| 500 | 0.0 | -0.1 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | -0.1 | 0.0 | ±1.0 |
| 8000 | -0.1 | -0.1 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.0 | -0.1 | +2.5; -16.0 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230303EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|------------------------|------------------------|---------------------------|
| C-weighting | 114.0 | 0.0 | ±0.2 |
| A-weighting | 114.0 | 0.0 | ±0.2 |
| Z-weighting | 114.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|------------------------|------------------------|---------------------------|
| Fast | 114.0 | 0.0 | ±0.1 |
| Slow | 114.0 | 0.0 | ±0.1 |
| LAeq | 114.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|--------------------------|--|------------------------|---------------------------|
| 30 | 114.0 | 114.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.1 | 0.1 | ±0.8 |
| 139.0 | 139.1 | 0.1 | ±0.8 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230303EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.4 | 0.4 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|---------------------------------|------------------------|------------------------|---------------------------|
| Fast | 200 | 136.0 | 0.0 | ±0.5 |
| | 2 | 118.8 | -0.2 | +1.0; -1.5 |
| | 0.25 | 109.6 | -0.4 | +1.0; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.8 | -0.2 | +1.0; -3.0 |
| | 200 | 130.0 | 0.0 | ±0.5 |
| LAE | 2 | 109.9 | -0.1 | +1.0; -1.5 |
| | 0.25 | 100.8 | -0.2 | +1.0; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------------------|---------------------------|------------------------|------------------------|---------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

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F-CAL-005 Ed.1

Certificate No.: CP20230303EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|----------------------------|----------------------------|------------------------|---------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 142.4 | 142.4 | 0.0 | ±1.5 |

Function : 11. High-Level Stability

High-Level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|-----------------------|--|------------------------|---------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 1.
3. The coverage factor $k = 2.00$

-- End of Report --

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE FOUNDATION FOR INDUSTRIAL DEVELOPMENT

975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37,

Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280

Tel: +66 2709 4860 Fax: +66 2324 0917



Certificate No.: CP20230304EA
Operation No.: CP2023070041

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007309 (Meter), 345239 (Microphone), 077644 (Preamplifier)

ID No.: UAE.EFM.041/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udumsuk 41, Sukhumvit Road, Bangchak
Phrakhanong, Bangkok 10260

Received Date: 24 July 2023

Calibrated Date: 7 - 9 August 2023

Issued Date: 10 August 2023

Calibrated by: Ms. Juntapom Kunhakom

Approved by: 
(Mr. Sittichai Swaksuriyawong)
Group Manager

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

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

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F-CAL-004 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230304EA

Calibration Report

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007309 (Meter), 345239 (Microphone), 077644 (Preamplifier)

ID No.: UAE.EFM.041/2566

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration
1. Reference standards instrument :-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|--|---------|------------|------------------------------|--------------------------------------|
| 1) Standard microphone | 4180 | 2787490 | AA-1024-22 | 6 November 2023 |
| 2) Arbitrary Function Generator | AFG2021 | C010063 | CK20230040EA | 26 June 2024 |
| 3) Programmable Attenuator | PA5 | 2755 | EF-0034-22 | 30 October 2023 |
| 4) 6.5 Digit precision multimeter | 8846A | 9610014 | CB20220223EA | 14 November 2023 |
| 5) Pressure humidity and Temperature Transmitter | PTU301 | F0640002 | CL1-P230024 CD20230196EA | 20 March 2024 23 July 2024 |
| 6) Pressure humidity and Temperature Transmitter | PTU301 | F0640003 | CL1-P230032 CD20230197EA | 4 April 2024 23 July 2024 |
| 7) Performance Audio Analyzer | U8903B | MY56510003 | CB20230038EA CK20220080EA | 14 February 2024 8 September 2023 |

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|-----------------------------------|------------------------|-------------------|---------------------------|
| 113.9 | 113.9 | 0.0 | ±0.7 |

Note : Absolute sensitivity was established by the use of the Sound Calibrator Larson Davis Type CAL200 5/N : 21091.

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F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230304EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

| Measured value (dB) |
|------------------------|
| 28.7 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|------------------------|------------------------|
| A-weighting | 28.4 |
| C-weighting | 28.4 |
| Z-weighting | 34.0 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.4 | 0.3 | 0.3 | ±1.0 |
| 1000 | 0.1 | 0.1 | 0.1 | ±0.7 |
| 8000 | -0.5 | -0.6 | -0.5 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.1 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.1 | 0.1 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | -0.1 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.1 | -0.1 | +2.5; -16.0 |

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F-CAL-005 Ed.1



ELECTRICAL AND ELECTRONICS INSTITUTE FOUNDATION FOR INDUSTRIAL DEVELOPMENT

Certificate No.: CP20230304EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|------------------------|------------------------|---------------------------|
| C-weighting | 114.0 | 0.0 | ±0.2 |
| A-weighting | 114.0 | 0.0 | ±0.2 |
| Z-weighting | 114.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|------------------------|------------------------|---------------------------|
| Fast | 114.0 | 0.0 | ±0.1 |
| Slow | 114.0 | 0.0 | ±0.1 |
| LAeq | 114.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|--------------------------|--|------------------------|---------------------------|
| 30 | 114.0 | 114.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.1 | 0.1 | ±0.8 |
| 139.0 | 139.1 | 0.1 | ±0.8 |

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F-CAL-005 Ed.1

Certificate No.: CP20230304EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.3 | 0.3 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|------------------------------|---------------------|---------------------|------------------------|
| Fast | 200 | 136.0 | 0.0 | ±0.5 |
| | 2 | 118.7 | -0.3 | +1.0 ; -1.5 |
| | 0.25 | 109.6 | -0.4 | +1.0 ; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0 ; -3.0 |
| | 200 | 130.0 | 0.0 | ±0.5 |
| LAE | 2 | 110.0 | 0.0 | +1.0 ; -1.5 |
| | 0.25 | 100.9 | -0.1 | +1.0 ; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------------|------------------------|---------------------|---------------------|------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

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F-CAL-005 Ed.1

Certificate No.: CP20230304EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 142.4 | 142.5 | 0.1 | ±1.5 |

Function : 11. High-Level Stability

High-Level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-----------------------------------|--------------------|--|---------------------|------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 1.
3. The coverage factor $k = 2.00$

-- End of Report --

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1Certificate No.: CP20230305EA
Operation No.: CP2023070042

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007310 (Meter), 345240 (Microphone), 077645 (Preamplifier)

ID No.: UAE.EFM.042/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak Phrakhanong, Bangkok 10260

Received Date: 24 July 2023

Calibrated Date: 7 - 9 August 2023

Issued Date: 10 August 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: 
(Mr. Sittichai Swaksuriyawong)
Group Manager

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

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

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เอกสารไม่ควบคุม
F-CAL-004 Ed.1

Certificate No.: CP20230305EA

Calibration Report

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007310 (Meter), 345240 (Microphone), 077645 (Preamplifier)

ID No.: UAE.EFM.042/2566

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Pressure: (101.3 ± 1.5) kPa

Method of Calibration :- IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|--|---------|------------|------------------------------|--------------------------------------|
| 1) Standard microphone | 4180 | 2787490 | AA-1024-22 | 6 November 2023 |
| 2) Arbitrary Function Generator | AFG2021 | C010063 | CK20230040EA | 26 June 2024 |
| 3) Programmable Attenuator | PA5 | 2755 | EF-0034-22 | 30 October 2023 |
| 4) 6.5 Digit precision multimeter | 8846A | 9610014 | CB20220223EA | 14 November 2023 |
| 5) Pressure humidity and Temperature Transmitter | PTU301 | F0640002 | CL1-P230024 CD20230196EA | 20 March 2024 23 July 2024 |
| 6) Pressure humidity and Temperature Transmitter | PTU301 | F0640003 | CL1-P230032 CD20230197EA | 4 April 2024 23 July 2024 |
| 7) Performance Audio Analyzer | U8903B | MY5651003 | CB20230038EA CK20220080EA | 14 February 2024 8 September 2023 |

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)
- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|--------------------------------|---------------------|----------------|------------------------|
| 113.9 | 113.9 | 0.0 | ±0.7 |

Note : Absolute sensitivity was established by the use of the Sound Calibrator Larson Davis Type CAL200 S/N : 21091.

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230305EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone installed

| Measured value (dB) |
|------------------------|
| 28.4 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|------------------------|------------------------|
| A-weighting | 28.3 |
| C-weighting | 28.5 |
| Z-weighting | 34.3 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.2 | 0.1 | 0.1 | ±1.0 |
| 1000 | 0.2 | 0.2 | 0.2 | ±0.7 |
| 8000 | -1.2 | -1.2 | -1.0 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | -0.1 | 0.0 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.0 | -0.1 | +2.5; -16.0 |

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F-CAL-005 Ed.1

Certificate No.: CP20230305EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|------------------------|------------------------|---------------------------|
| C-weighting | 114.0 | 0.0 | ±0.2 |
| A-weighting | 114.0 | 0.0 | ±0.2 |
| Z-weighting | 114.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|------------------------|------------------------|---------------------------|
| Fast | 114.0 | 0.0 | ±0.1 |
| Slow | 114.0 | 0.0 | ±0.1 |
| LAeq | 114.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|--------------------------|--|------------------------|---------------------------|
| 30 | 114.0 | 114.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 139.0 | 139.0 | 0.0 | ±0.8 |

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F-CAL-005 Ed.1

Certificate No.: CP20230305EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------|------------------------|------------------------|---------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.3 | 0.3 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-------------------|---------------------------------|------------------------|------------------------|---------------------------|
| Fast | 200 | 136.0 | 0.0 | ±0.5 |
| | 2 | 118.8 | -0.2 | +1.0; -1.5 |
| | 0.25 | 109.8 | -0.2 | +1.0; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0; -3.0 |
| | 200 | 130.0 | 0.0 | ±0.5 |
| LAE | 2 | 110.0 | 0.0 | +1.0; -1.5 |
| | 0.25 | 100.9 | -0.1 | +1.0; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------------------|---------------------------|------------------------|------------------------|---------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

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เอกสารไม่ควบคุม
F-CAL-005 Ed.1

Certificate No.: CP20230305EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|----------------------------|----------------------------|------------------------|---------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 142.2 | 142.4 | 0.2 | ±1.5 |

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|-----------------------|--|------------------------|---------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks: 1. The acceptance limit is for the deviated value.
2. Acceptance limits was IEC61672-3:2013 Class 1.
3. The coverage factor $k = 2.00$

- - End of Report - -

Page 6 of 6

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F-CAL-005 Ed.1

Certificate of Calibration

Customer
Name UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD. Certificate No : 23-SLM-296
Address 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok Request No : Req-2023-1854
10260

Unit Under Calibration Details

Measurement item : Sound Level Meter Microphone Class : 1
Manufacturer : LARSON DAVIS Microphone Model : 377B02
Model : LxT1 Microphone S/N : 345817
Serial Number : 0007311 Preamplifier Model : PRMLxT1
ID : UAE.EFM.043/2566 Preamplifier S/N : 077646
Resolution : 0.1 dB Instrument Status : Used


Calibration Environment and Details


Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 30 August 2023
Calibrated Date : 6 September 2023
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests
Location of Calibration : Lab Acoustic

Reference Standard

| Instrument | Brand | Model | SN. | Due calibration | Traceability |
|---------------------------|--------|-----------|-----------|-----------------|--------------|
| Standard Microphone | GRAS | 40AN | 188273 | 6 October 2023 | GRAS |
| Multifrequency Calibrator | Quest | Quest-cal | EFA000234 | 25 July 2024 | TSI |
| Audio Generator | Svanck | Svan401 | 131 | 12 October 2023 | WK Electric |

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

Calibrated By : 
Mr. Noppadon Luangart
Calibration Officer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 6 September 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Calibration Laboratory.
FM-708-SLM-01 Rev.0 Issue date 1/7/19.

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Certificate No : 23-SLM-296
Request No : Req-2023-1854

1. Indication at the calibration check frequency

| UUC Setting | Nominal | Before Adjust | After Adjust | UNCERTAINTY | Acceptance |
|--------------------|---------|---------------|--------------|-------------|------------|
| FAST / A / 37-139 | Level | UUC | ERR | UUC | Limit |
| Calibrator Setting | (dB) | (dB) | (dB) | (dB) | (± dB) |
| 1000 Hz 114 dB | 113.78 | 114.0 | +0.22 | 113.8 | +0.02 |

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN. 58079

2. Self-generated noise, Microphone installed

| UUC Setting | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 | (dB) | (± dB) |
| UUC Weighting | (dB) | (± dB) |
| A | 28.0 | 0.1 |

3. Self-generated noise, Microphone replaced by the electrical input signal device

| UUC Setting | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 | (dB) | (± dB) |
| UUC Weighting | (dB) | (± dB) |
| A | 27.5 | 0.1 |
| C | 27.5 | 0.1 |
| Z | 31.9 | 0.1 |

4. Acoustic signal test of frequency weightings (Without Windscreen)

| UUC Setting | Deviation from various Frequency Weighting Response curve | UNCERTAINTY | Acceptance Limit |
|---------------|---|-------------|------------------|
| FAST / 37-139 | A C Z | (± dB) | (± dB) |
| STD Setting | (dB) (dB) (dB) | (± dB) | (± dB) |
| 125 Hz | 0.1 0.2 0.2 | 0.6 | 1.0 |
| 1000 Hz | 0.0 0.0 0.0 | 0.6 | 0.7 |
| 4000 Hz | -0.2 -0.1 -0.1 | 0.6 | 1.0 |
| 8000 Hz | -0.7 -0.7 -0.5 | 0.7 | +1.5 -2.5 |

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Certificate No : 23-SLM-296
Request No : Req-2023-1854

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

| UUC Setting | Deviation from various Frequency Weighting Response curve | UNCERTAINTY | Acceptance Limit |
|---------------|---|-------------|------------------|
| FAST / 37-139 | A (dB) C (dB) Z (dB) | (± dB) | (± dB) |
| STD Setting | (dB) (dB) (dB) | (± dB) | (± dB) |
| 63 Hz | -0.2 -0.1 -0.1 | 0.2 | 1.0 |
| 125 Hz | -0.1 0.0 -0.1 | 0.2 | 1.0 |
| 250 Hz | -0.1 -0.1 -0.1 | 0.2 | 1.0 |
| 500 Hz | -0.1 0.0 0.0 | 0.2 | 1.0 |
| 1000 Hz | 0.0 0.0 0.0 | 0.2 | 0.7 |
| 2000 Hz | 0.0 0.0 0.0 | 0.2 | 1.0 |
| 4000 Hz | 0.0 0.0 0.0 | 0.2 | 1.0 |
| 8000 Hz | -0.1 -0.1 0.0 | 0.2 | +1.5 -2.5 |
| 16000 Hz | -0.1 -0.1 -0.1 | 0.2 | +2.5 -16.0 |

6. Frequency and time weightings at 1kHz

| UUC Setting | STD | Measured | UNCERTAINTY | Acceptance Limit |
|---------------|--------|----------|-------------|------------------|
| FAST / 37-139 | REF | UUC | ERR | (± dB) |
| UUC Weighting | (dB) | (dB) | (dB) | (± dB) |
| A | 114.00 | 114.0 | 0.0 | 0.2 |
| C | 114.00 | 114.0 | 0.0 | 0.2 |
| Z | 114.00 | 114.0 | 0.0 | 0.2 |

| UUC Setting | STD | Measured | UNCERTAINTY | Acceptance Limit |
|-------------------|--------|----------|-------------|------------------|
| 37-139 / A | REF | UUC | ERR | (± dB) |
| UUC Time Response | (dB) | (dB) | (dB) | (± dB) |
| Fast | 114.00 | 114.0 | 0.0 | 0.1 |
| Slow | 114.00 | 114.0 | 0.0 | 0.1 |
| Leq | 114.00 | 114.0 | 0.0 | 0.1 |

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Certificate No : 23-SLM-296
Request No : Req-2023-1854

7. Long Term Stability

| UUC Setting | Measured | UNCERTAINTY | Acceptance Limit |
|-------------------|----------|-------------|------------------|
| FAST / A / 37-139 | UUC | (± dB) | (± dB) |
| STD Setting | (dB) | (± dB) | (± dB) |
| Initial | 114.0 | 0.1 | 0.1 |
| Final | 114.0 | 0.1 | 0.1 |
| Deviated | 0.0 | 0.1 | 0.1 |

8. Level linearity on the reference level range

| UUC Setting | Anticipated | Deviation | UNCERTAINTY | Acceptance Limit |
|-------------------|-------------|-----------|-------------|------------------|
| FAST / A / 37-139 | REF | UUC | ERR | (± dB) |
| STD dB | (dB) | (dB) | (dB) | (± dB) |
| 139.00 | 139 | 139.0 | 0.0 | 0.8 |
| 134.00 | 134 | 134.0 | 0.0 | 0.8 |
| 129.00 | 129 | 129.0 | 0.0 | 0.8 |
| 124.00 | 124 | 124.0 | 0.0 | 0.8 |
| 119.00 | 119 | 119.0 | 0.0 | 0.8 |
| 114.00 | 114 | 114.0 | 0.0 | 0.8 |
| 109.00 | 109 | 109.0 | 0.0 | 0.8 |
| 104.00 | 104 | 104.0 | 0.0 | 0.8 |
| 99.00 | 99 | 99.0 | 0.0 | 0.8 |
| 94.00 | 94 | 93.9 | -0.1 | 0.8 |
| 89.00 | 89 | 88.9 | -0.1 | 0.8 |
| 84.00 | 84 | 83.9 | -0.1 | 0.8 |
| 79.00 | 79 | 78.9 | -0.1 | 0.8 |
| 74.00 | 74 | 73.9 | -0.1 | 0.8 |
| 69.00 | 69 | 68.9 | -0.1 | 0.8 |
| 64.00 | 64 | 63.9 | -0.1 | 0.8 |
| 59.00 | 59 | 58.9 | -0.1 | 0.8 |
| 54.00 | 54 | 53.9 | -0.1 | 0.8 |
| 49.00 | 49 | 49.0 | 0.0 | 0.8 |
| 44.00 | 44 | 44.0 | 0.0 | 0.8 |
| 39.00 | 39 | 39.3 | 0.3 | 0.8 |
| 38.00 | 38 | 38.4 | 0.4 | 0.8 |
| 37.00 | 37 | 37.5 | 0.5 | 0.8 |
| 36.00 | 36 | 36.6 | 0.6 | 1.8 |

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Certificate No : 23-SLM-296
Request No : Req-2023-1854

9. Level linearity including the level range control

| UUC Setting | STD | Measured | | UNCERTAINTY | Acceptance |
|-------------|------|----------|------|-------------|------------|
| FAST / A | REF | UUC | ERR | (± dB) | Limit |
| UUC Range | (dB) | (dB) | (dB) | | (± dB) |
| 37-139 | 41.3 | 41.5 | 0.2 | 0.3 | 0.8 |
| | 114 | 114.0 | 0.0 | | 0.8 |

10. Tone burst response

| UUC Setting | STD | Anticipated | Measured | | UNCERTAINTY | Acceptance |
|-------------------|-----------|-------------|----------|------|-------------|------------|
| A / 37-139 | Toneburst | Ref | UUC | ERR | (± dB) | Limit |
| UUC Time Response | (ms) | (dB) | (dB) | (dB) | | (± dB) |
| Fast | 200 | 135.0 | 135.0 | 0.0 | 0.2 | 0.5 |
| | 2 | 118.0 | 117.7 | -0.3 | | +1.0, -1.5 |
| | 0.25 | 109.0 | 108.6 | -0.4 | | +1.0, -3.0 |
| Slow | 200 | 128.6 | 128.5 | -0.1 | | 0.5 |
| | 2 | 109.0 | 108.9 | -0.1 | | +1.0, -3.0 |
| | 0.25 | 109.0 | 109.0 | 0.0 | | 0.5 |
| SEL | 200 | 129.0 | 129.0 | 0.0 | | +1.0, -1.5 |
| | 2 | 109.0 | 109.0 | 0.0 | | +1.0, -1.5 |
| | 0.25 | 100.0 | 99.9 | -0.1 | | +1.0, -3.0 |

11. Peak C Sound level

| UUC Setting | Anticipated | Measured | | UNCERTAINTY | Acceptance |
|---------------------|-------------|----------|-------|-------------|------------|
| FAST / C / 95-142 | REF | UUC | ERR | (± dB) | Limit |
| STD Setting | (dB) | (dB) | (dB) | | (± dB) |
| Complete cycle | 137.4 | 136.6 | -0.80 | 0.2 | 2.0 |
| Positive half cycle | 136.4 | 136.1 | -0.30 | | 1.0 |
| Negative half cycle | 136.4 | 136.1 | -0.30 | | 1.0 |

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Certificate No : 23-SLM-296
Request No : Req-2023-1854

12. Overload indication

| UUC Setting | Measured | UNCERTAINTY | Acceptance |
|-------------------------|----------|-------------|------------|
| FAST / A / 37-139 | UUC | (± dB) | Limit |
| STD Setting | (dB) | | (± dB) |
| Positive one-half cycle | 139.9 | | |
| Negative one-half cycle | 139.9 | | |
| Deviated | 0.0 | 0.2 | 1.5 |

13. High Level Stability

| UUC Setting | Measured | UNCERTAINTY | Acceptance |
|-------------------|----------|-------------|------------|
| FAST / A / 37-139 | UUC | (± dB) | Limit |
| STD Setting | (dB) | | (± dB) |
| Initial | 138.0 | | |
| Final | 138.0 | | |
| Deviated | 0.0 | 0.1 | 0.1 |

End of Certificate

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FM-708-SLM-01 Rev.0 Issue Date 1/7/19.

Env Equipment Service Co., Ltd.
EES

Envi Equipment Service Co., Ltd.
110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110
Tel. 098 362 9152, 089 478 7885
E-mail: sales@envi-ees.com

Certificate No. : E23-12095
Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment : Console meter
Manufacturer : Apex Instrument
Model Number : XC-572-V
Serial Number : 1701018
ID./Control No. : -
Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH
Cal. Date : 09/12/2023
Issue Date : 09/12/2023

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved by : (Mr. Mana Fuekhud)
Technical Manger



เอกสารไม่ควบคุม

Env Equipment Service Co., Ltd.
EES

Certificate No. : E23-12095
Page : 2 of 6

METHOD 5 CONSOLE CALIBRATION USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425 5-POINT METRIC UNIT

| Meter Console Information | | Calibration Conditions | | | Factors/Conversions | |
|---------------------------|----------|---------------------------|-------------|---------------------|---------------------|-----------|
| Console Model Number | XC-572-V | Date | Time | 09/12/2023 11:40 AM | Std Temp | 293 K |
| Console Serial Number | 1701018 | Calibration Reference No. | SER23-12095 | | Std Press | 760 mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | 759.66 | mmHg | K _t | 0.386 |
| DGM Serial Number | 00002030 | Calibration Meter Gamma | 0.999 | | Console Leak Check | PASS |

| Calibration Data | | | | | | | | | |
|------------------|---------------------|-------------------|-------------------|---------------------|-------------------|-------------------|-------------------|---------------------|-------------------|
| Run Time | | Metering Console | | | | Calibration Meter | | | |
| Elapsed | DGM Orifice DH | Volume Initial | Volume Final | Outlet Temp Initial | Outlet Temp Final | Volume Initial | Volume Final | Outlet Temp Initial | Outlet Temp Final |
| (Q) | (P _m) | (V _m) | (V _m) | (t _m) | (t _m) | (V _w) | (V _w) | (t _w) | (t _w) |
| min | mm H ₂ O | m ³ | m ³ | °C | °C | m ³ | m ³ | °C | °C |
| 12.48 | 13.0 | 2395.552 | 2395.692 | 29 | 29 | 184.31872 | 184.46072 | 28 | 28 |
| 12.48 | 13.0 | 2395.692 | 2395.832 | 29 | 29 | 184.46072 | 184.60178 | 28 | 28 |
| 8.70 | 26.0 | 2395.839 | 2395.979 | 30 | 30 | 184.60924 | 184.75154 | 28 | 28 |
| 8.72 | 26.0 | 2395.979 | 2396.119 | 30 | 30 | 184.75154 | 184.89358 | 28 | 28 |
| 14.52 | 40.0 | 2396.133 | 2396.413 | 31 | 31 | 184.90784 | 185.19162 | 28 | 28 |
| 14.47 | 40.0 | 2396.413 | 2396.693 | 32 | 32 | 185.19162 | 185.47356 | 27 | 27 |
| 10.77 | 70.0 | 2396.701 | 2396.981 | 32 | 32 | 185.48168 | 185.76272 | 27 | 27 |
| 10.73 | 70.0 | 2396.981 | 2397.261 | 32 | 32 | 185.76272 | 186.04256 | 27 | 27 |
| 9.43 | 90.0 | 2397.272 | 2397.552 | 33 | 33 | 186.05334 | 186.33194 | 27 | 27 |
| 9.42 | 90.0 | 2397.552 | 2397.832 | 33 | 33 | 186.33194 | 186.60946 | 27 | 27 |



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METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

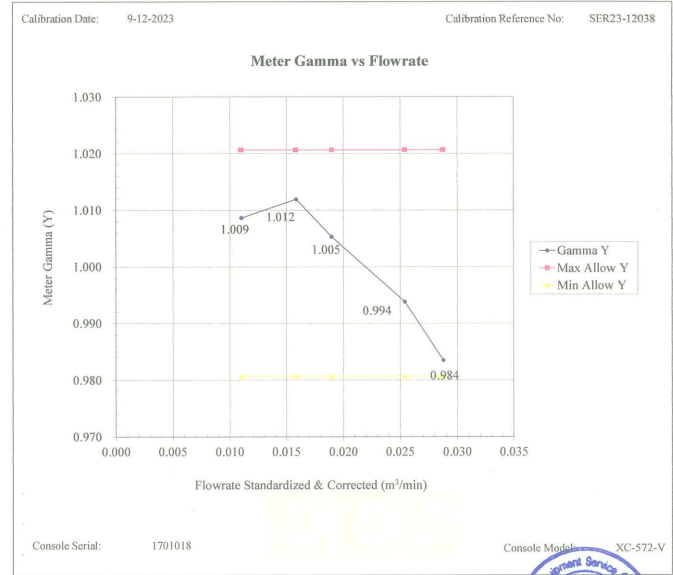
| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|-------------|------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 09/12/2023 | 11:40 AM | Std Temp | 293 | K |
| Console Serial Number | 1701018 | Calibration Reference No. | SER23-12095 | | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | 759.66 | mmHg | | K ₁ | 0.386 | |
| DGM Serial Number | 00002030 | Calibration Meter Gamma | 0.999 | | | Console Leak Check | PASS | |

| Calibration Data | | | | | | | | | |
|------------------------|------------------------|------------------------|------------------------|--------------------|----------------|--|--|------------------------------|--|
| Results | | | | | | | | | |
| Standardized Data | | | | Dry Gas Meter | | | | | |
| Dry Gas Meter | | Calibration Meter | | Calibration Factor | | Flowrate | | | |
| (V _{m(std)}) | (Q _{m(std)}) | (V _{w(std)}) | (Q _{w(std)}) | Value (Y) | Variation (ΔY) | Std & Corr (Q _{m(std)/corr}) | .0212 m ³ /min (ΔH _g) | Variation (ΔH _g) | |
| m ³ | m ³ /min | m ³ | m ³ /min | | | m ³ /min | mm H ₂ O | | |
| 0.136 | 0.011 | 0.138 | 0.011 | 1.012 | 0.011 | 0.011 | 46.771 | -0.951 | |
| 0.136 | 0.011 | 0.137 | 0.011 | 1.005 | 0.005 | 0.011 | 47.396 | -0.325 | |
| 0.137 | 0.016 | 0.138 | 0.016 | 1.013 | 0.012 | 0.016 | 45.356 | -2.365 | |
| 0.137 | 0.016 | 0.138 | 0.016 | 1.011 | 0.010 | 0.016 | 45.697 | -2.024 | |
| 0.273 | 0.019 | 0.276 | 0.019 | 1.009 | 0.008 | 0.019 | 48.982 | 1.261 | |
| 0.274 | 0.019 | 0.275 | 0.019 | 1.002 | 0.001 | 0.019 | 49.119 | 1.398 | |
| 0.275 | 0.026 | 0.274 | 0.025 | 0.996 | -0.005 | 0.025 | 48.195 | 0.473 | |
| 0.275 | 0.026 | 0.273 | 0.025 | 0.992 | -0.009 | 0.025 | 48.308 | 0.587 | |
| 0.276 | 0.029 | 0.272 | 0.029 | 0.985 | -0.015 | 0.029 | 48.591 | 0.869 | |
| 0.276 | 0.029 | 0.271 | 0.029 | 0.982 | -0.019 | 0.029 | 48.797 | 1.076 | |
| | | | | 1.001 | Y Average | | 47.721 | ΔH _g Average | |

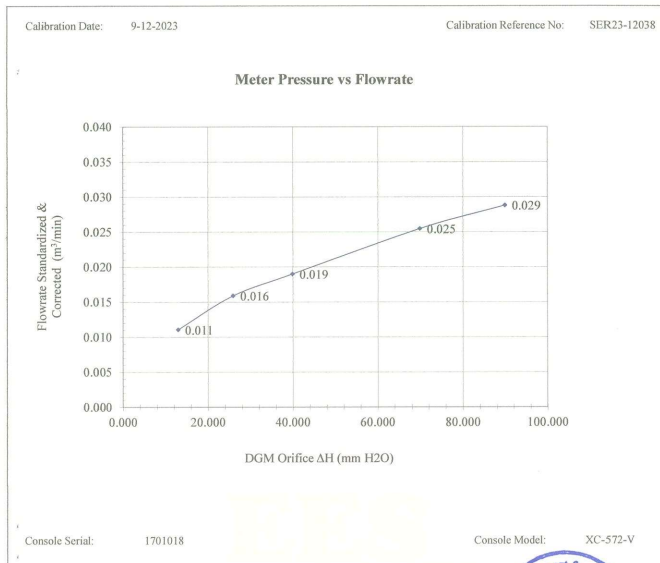
Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For ΔH_g, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.



| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|-------------|------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 09/12/2023 | 11:40 AM | Std Temp | 293 | K |
| Console Serial Number | 1701018 | Calibration Reference No. | SER23-12095 | | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | 759.66 | mmHg | | K ₁ | 0.386 | |
| DGM Serial Number | 00002030 | Calibration Meter Gamma | 0.999 | | | Console Leak Check | PASS | |



| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|-------------|------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 09/12/2023 | 11:40 AM | Std Temp | 293 | K |
| Console Serial Number | 1701018 | Calibration Reference No. | SER23-12095 | | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | 759.66 | mmHg | | K ₁ | 0.386 | |
| DGM Serial Number | 00002030 | Calibration Meter Gamma | 0.999 | | | Console Leak Check | PASS | |



THERMOCOUPLES SYSTEM CALIBRATION

| Sampling System Equipment Information | | Calibration Conditions | | | |
|---------------------------------------|--------------|---------------------------|-------------|------------|----------|
| Console Model Number | XC-572-V | Date | Time | 09/12/2023 | 01:45 PM |
| Console Serial Number | 1701018 | Calibration Reference No. | SER23-12095 | | |
| DGM Model Number | SK25EX | Reference Thermometer | DIGICON | | |
| DGM Serial Number | 00002030 | Serial Number | 183169105 | | |
| Meter Box Model Number | JENCO 765 KF | | | | |
| Meter Box Serial Number | JC 16103 | | | | |

| Results | | | | | | | | | | | |
|--------------------------------|--|------|------|------|-------|-------|-------|-------|-------|-------|--------|
| 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 | -17.0 | 25.0 | 38.0 | 94.0 | 150.0 | 259.0 | 372.0 | 482.0 | 593.0 | 815.0 | 1037.0 |
| Aux | -17.0 | 25.0 | 38.0 | 94.0 | 150.0 | | | | | | |
| Probe | -17.0 | 25.0 | 38.0 | 94.0 | 150.0 | | | | | | |
| Filter | -17.0 | 25.0 | 39.0 | 94.0 | 150.0 | | | | | | |
| Oven | -17.0 | 25.0 | 38.0 | 94.0 | 150.0 | | | | | | |
| Exit | -17.0 | 26.0 | 39.0 | | | | | | | | |

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



Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 03099402/701
Instrument serial no. : 60899617/701
ID no. or control no. : UAE.EFM. 007/2560
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial no. : -
Customer name : United Analyst and Engineering Consultant Co., Ltd.
Customer address : 81 Soi Udomsuk 41, Sukhumvit Rd., Bangchak, Phrakhanong, Bangkok 10260

Total pages of certificate : 2 Pages
Receiving no. : L-233264
Receiving date. : 28-Sep-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm, Nitrogen Dioxide 30.34,80.96,201.9 ppm, Nitric Oxide 30.01,151.5,322.5 ppm, Sulphur Dioxide 50.36,100.8,600.8 ppm)

Condition of UUC. : Used
Ambient condition : All of the Measurment were caried out the stabilized labatory
Temperature : 23 ±5 °C
Humidity : 55 ± 15 %RH

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

Calibration procedure no.: This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent 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 and The results relate only to the items tested/calibrated.

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

Date of calibration : 05-Oct-23


Mr. Kwanchai Khamdoung
Calibration Technician


Mrs. Nongluck Wongsettee
Technical Manager

FM-CL-09-C Rev.8

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Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Neamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

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Standard References (Table 1)

| Standard | Certificate No. | Vendor | Due date |
|------------------------------------|-----------------|--------|-----------|
| Oxygen (O2) 2.498 % Vol | 4219/21 | Linde | 30-Sep-25 |
| Oxygen (O2) 10.04 % Vol | CG-0153-21 | Nimt | 18-Nov-26 |
| Oxygen (O2) 21.02 % Vol | CG-0041-22 | Nimt | 10-Feb-27 |
| Carbon monoxide (CO) 80.14 ppm | CG-0040-22 | Nimt | 14-Feb-27 |
| Carbon monoxide (CO) 302 ppm | 1915/23 | Linde | 16-Jun-25 |
| Carbon monoxide (CO) 1003 ppm | 2584/23 | Linde | 10-Sep-25 |
| Nitrogen Dioxide (NO2) 30.34 ppm | 2703/22 | Linde | 22-Aug-24 |
| Nitrogen Dioxide (NO2) 80.96 ppm | 3240/21 | Linde | 26-Jun-24 |
| Nitrogen Dioxide (NO2) 201.9 ppm | 1975/23 | Linde | 17-Jul-25 |
| Nitric Oxide (NO) 30.01 ppm | CG-0014-23 | Nimt | 19-Feb-25 |
| Nitric Oxide (NO) 151.5 ppm | 0161/23 | Linde | 22-Jan-25 |
| Nitric Oxide (NO) 322.5 ppm | 1974/23 | Linde | 17-Jul-25 |
| Sulphur Dioxide (SO2) 50.36 ppm | 2004/23 | Linde | 17-Jul-25 |
| Sulphur Dioxide (SO2) 100.8 ppm | 3507/22 | Linde | 09-Nov-24 |
| Sulphur Dioxide (SO2) 600.8 ppm | 2003/23 | Linde | 17-Jul-25 |

Measured room conditions

Temperature : 22.1 °C Humidity : 66.7 %RH Pressure : 1009.4 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1019.4 mbar

Calibration Results (Without adjustment) (Table 2)

| Parameter of Standard | Standard | Mean of | Error | Uncertainty |
|-----------------------|----------|---------|--------|-------------|
| | Values | UUC | | |
| O2 (%Vol) | 2.498 | 2.48 | -0.018 | 0.15 |
| O2 (%Vol) | 10.04 | 10.07 | 0.03 | 0.20 |
| O2 (%Vol) | 21.02 | 21.10 | 0.08 | 0.30 |
| CO (ppm) | 80.14 | 81 | 0.86 | 3.0 |
| CO (ppm) | 302 | 304 | 2 | 6.0 |
| CO (ppm) | 1003 | 1008 | 5 | 12 |
| NO2 (ppm) | 30.34 | 28.2 | -2.14 | 8.0 |
| NO2 (ppm) | 80.96 | 80.5 | -0.46 | 8.0 |
| NO2 (ppm) | 201.9 | 204.7 | 2.8 | 12 |
| NO (ppm) | 30.01 | 29 | -1.01 | 8.0 |
| NO (ppm) | 151.5 | 152 | 0.5 | 8.0 |
| NO (ppm) | 322.5 | 322 | -0.5 | 12 |
| SO2 (ppm) | 50.36 | 50 | -0.36 | 6.0 |
| SO2 (ppm) | 100.8 | 103 | 2.2 | 6.0 |
| SO2 (ppm) | 600.8 | 606 | 5.2 | 13 |

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

End of Report

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Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Neamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel. 0-2779-8888 Calibration@entech.co.th
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FM-CL-09-C Rev.8

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO.,LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAE0.
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (660) 2116-5860-1 FAX: (660) 2116-7140



Page 1 of 2.

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING
CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Prakanong, Bangkok 10260

Certificate No : 23-ACT-117
Request No : Req-2023-1546

Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1
Manufacturer : SVANTEK Range : 94 , 114 dB / 1000 Hz
Model : SV 36 Intrument Status : Used
Serial Number : 107224
ID : UAE.EFM.171/2564

Calibration Environment and Details


Temperature : (23 ±2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ±10.0 hPa)
Received Date : 21 July 2023
Calibration Date : 4 August 2023
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


| Reference Standard | Model | Serial Number | Traceable | Due Calibration |
|--------------------|--------|---------------|-----------|-----------------|
| Sound Calibrator | SV 35A | 58079 | EEI | 31 May 2024 |
| THD Multimeter | 2015 | 1047765 | NIMT | 31 January 2024 |

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 %.

Calibrated By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 4 August 2023

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.

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Page 2 of 2.

Certificate No : 23-ACT-117

Request No : Req-2023-1546

Sound pressure level

Calibration Results : Without Adjustment

| Calibration Range (dB) | Without Adjustment (dB) | | Adjustment (dB) | | Uncertainty (± dB) | Acceptance limit Class 1 (± dB) |
|---------------------------|-------------------------|-------|-----------------|-------|------------------------|-------------------------------------|
| | Measured | Error | Measured | Error | | |
| 94 dB / 1000 Hz | 94.03 | 0.03 | - | - | 0.13 | 0.25 |
| 114 dB / 1000 Hz | 114.11 | 0.11 | - | - | 0.13 | 0.25 |

Frequency of Sound pressure level

| Calibration Range (Hz) | Without Adjustment | | Adjustment | | Uncertainty (± %) | Acceptance limit Class 1 (± %) |
|---------------------------|--------------------|-----------|---------------|-----------|-----------------------|------------------------------------|
| | Measured (Hz) | Error (%) | Measured (Hz) | Error (%) | | |
| 94 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 0.70 |
| 114 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 0.70 |

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

| Calibration Range (Hz) | Without Adjustment | | Adjustment | | Uncertainty (± %) | Acceptance limit Class 1 (± %) |
|---------------------------|--------------------|--|--------------|--|-----------------------|------------------------------------|
| | Measured (%) | | Measured (%) | | | |
| 94 dB / 1000 Hz | 0.26 | | - | | 0.40 | 2.5 |
| 114 dB / 1000 Hz | 0.38 | | - | | 0.40 | 2.5 |

Note :

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

End of Calibration

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.

เอกสารไม่ควบคุม

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00558210 / 157969 / 48065
ID No.: UAE.EFM.042/2558

Condition As Found : GOOD

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT (UAE)
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK SUB-DISTRICT,
PHRAKHANONG DISTRICT, BANGKOK 10260
THAILAND.

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 07 NOVEMBER 2023
Calibration Date : 07-08 NOVEMBER 2023
Date of Issue : 08 NOVEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :


(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced
other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL23341
Job No. : VC67AC0020
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|---------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

Note : Pass/Fail evaluation for each parameter,
will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QF-TS12-04-04-020664

เอกสารไม่ควบคุม
T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23341
Job No. : VC67AC0020
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference
Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0009-23 | 07-FEB-24 |
| Waveform Generator | 33511B | MY52302742 | EF-0010-23 | 07-FEB-24 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP 30/0266 | 13-FEB-24 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP 29/0266 | 13-FEB-24 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP 31/0266 | 14-FEB-24 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0011-23 | 08-FEB-24 |
| Condenser Microphone | 4180 | 2977900 | AA-1001-23 | 14-FEB-24 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3002-23 | 14-FEB-24 |

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

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

- 3.1 National Institute of Metrology (Thailand).
3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

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T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23341
Job No. : VC67AC0020
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.98) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|--------------------------|
| 20.3 |

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

| Frequency Weighting | Measured value (dB) |
|------------------------|--------------------------|
| A - weight | 14.8 |
| C - weight | 20.7 |
| Flat | 26.7 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | -0.7 | -0.7 | -0.5 | ± 1.5 |
| 1000 | -0.7 | -0.7 | -0.6 | ± 1.0 |
| 8000 | 0.1 | 0.2 | 0.1 | ±5.0 |

QF-TS12-04-04-020664

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T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23341
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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | -0.1 | -0.1 | -0.1 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.2 |
| C - weight | 94.0 | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 94.0 | 94.0 | 0.0 | ± 0.1 |
| Slow | 94.0 | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |

QF-TS12-04-04-020664

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7. Pethu.

Continuation of Calibration Certificate

Cert. No. : ACL23341
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7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.1 | 0.1 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 28.0 | 0.0 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 26.0 | 0.0 | ± 1.1 |
| 25.0 | 24.9 | -0.1 | ± 1.1 |

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7. Pethu.

Continuation of Calibration Certificate

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8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------|--------------------------------------|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| SEL | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, Lcpeak (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|-------------------------------------|-----------------------------|--------------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | ±3.0 |
| One | 136.4 | 135.8 | -0.6 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | ±2.0 |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |

QF-TS12-04-04-020664

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7. Pethu.

Continuation of Calibration Certificate

Cert. No. : ACL23341
Job No. : VC67AC0020
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11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------------------|----------------------------|-----------------------------|--------------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.5 | 89.5 | 0.0 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$
or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

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