

เอกสารแนบที่ จ

เอกสารรับรองการสอบเทียบเครื่องมือ

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 <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_orifice inH <sub>2</sub> O	y'	Standard Flow [Qs] m <sup>3</sup> /min
1	0.699	756.468	24.680	23.730	55.667	1.705	1.303	0.647
2	1.001	756.479	24.910	24.180	61.363	3.454	1.855	0.918
3	1.114	756.494	24.550	23.970	41.751	4.535	2.126	1.051
4	1.166	756.510	24.470	23.900	30.652	5.138	2.264	1.118
5	1.416	756.534	24.400	24.150	30.200	7.619	2.757	1.357

Slope (a): 2.04689  
Intercept (b): -0.02301  
Correlation coefficient (r): 0.99987  
Uncertainty (k=2): 0.010 m<sup>3</sup>/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_orifice inH <sub>2</sub> O	y'	Standard Flow [Qs] m <sup>3</sup> /min
1	0.699	756.468	24.680	23.730	55.667	1.705	0.819	0.649
2	1.001	756.479	24.910	24.180	61.363	3.454	1.167	0.922
3	1.114	756.494	24.550	23.970	41.751	4.535	1.336	1.054
4	1.166	756.510	24.470	23.900	30.652	5.138	1.422	1.121
5	1.416	756.534	24.400	24.150	30.200	7.619	1.731	1.360

Slope (a): 1.28208  
Intercept (b): -0.01449  
Correlation coefficient (r): 0.99987  
Uncertainty (k=2): 0.011 m<sup>3</sup>/min

\*\*\*End of Certificate of Calibration\*\*\*



เอกสารไม่ควบคุม

CERTIFICATE OF CALIBRATION

Certificate No. : CL-004-55

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice  
MANUFACTURER : Tisch Environmental Inc.  
MODEL/TYPE : TE-5025A  
SERIAL NUMBER : 3393  
ID NUMBER : UAE.EFM.054/2560  
CONDITION AS-RECEIVED : Used item  
CUSTOMER : United Analyst and Engineering Consultant Co.,Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,  
Bangkok 10260

Calibration procedure:  
The Orifice gas flow device was calibrated against  
Standard Rotary Displacement Meter (Roots  
Meter) Model G65/MCQ/M2-dp. The WH-CL-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: G2211501

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'

RECEIVED DATE : 15 Jul 2022  
MEASUREMENT DATE : 25 Jul 2022  
ISSUE DATE : 26 Jul 2022

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 24.7 °C and 52.1 %RH.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol

Approved signatory:





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

Cert.No.: 22P915  
Page: 2 of 2

## Certificate of Calibration

Certificate No.: 22P915  
Page: 1 of 2

Equipment:

U Tube Manometer

Manufacturer:

Dwyer

Model:

1221-36-W/M

Serial No.:

-

ID No.:

UAE.EMA2.095/2555

Condition As-Received:

Used Item

Received Date:

01 July 2022

Calibration Date:

11 July 2022

Reference:

2202-0083WSC

Ambient Temperature:

( 23 ± 2 ) °C

Relative Humidity:

( 50 ± 15 ) %

Atmospheric Pressure:

1012 mbar

Procedure used:

The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-PDA, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument

1) Pressure Calibrator

Model

PC106P

Serial No.

1189

Certificate No.

MP-0113-22

Due Date

14 Jul 2023

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

3.Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O

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

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

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 at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Nopparat Phonang

Issue Date: 11 July 2022

Approved Signatory:

Attapol P.

[ ] Phalinee Prabpalai

[ ] Sura Suwanasart

[x] Attapol Panurach

Attapol P.  
เอกสารไม่ควบคุม  
a 1037942

เอกสารไม่ควบคุม  
B 0250405

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

Range: 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O

Scale Interval: 0.1 inH<sub>2</sub>O (The Fifth Estimate)

Applied Pressure (inH <sub>2</sub> O)	UUC Indication		Error (inH <sub>2</sub> O)
	High-port side (inH <sub>2</sub> O)	Low-port side (inH <sub>2</sub> O)	
0.00	0.00	0.00	0.00
2.00	1.02	-1.02	2.04
4.00	1.98	-1.98	3.96
6.00	2.98	-2.98	5.96
10.00	4.98	-4.98	9.96
12.00	6.00	-5.98	11.98
14.00	7.02	-6.98	14.00
16.00	8.02	-8.00	16.02
18.00	9.04	-9.00	18.04
20.00	10.04	-10.00	20.04
22.00	11.06	-11.00	22.06
24.00	12.06	-12.00	24.06
26.00	13.06	-13.00	26.06
28.00	14.06	-14.02	28.08
30.00	15.06	-15.02	30.08
32.00	16.06	-16.02	32.08
34.00	17.06	-17.02	34.08
35.80	17.98	-17.92	35.90

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O

\* UUC = Unit Under Calibration

\* ΔP = High-port side - Low-port side

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 %.

-o0o-

Certificate No : 22-AFM-140  
Request No : Req-2022-1607

Result of Calibration :

Flow Setting	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
(LPM)	(LPM)	(LPM)	(LPM)	(LPM)
14.5	14.50	14.57	-0.07	0.21
15.0	15.00	15.09	-0.09	0.22
15.8	15.80	15.88	-0.08	0.23
16.6	16.60	16.67	-0.07	0.24
18.3	18.30	18.40	-0.10	0.26

Note  
STD : Standard  
UUC Unit Under Calibration  
Calibration media : Air  
\* Indicates non accredited

End of Certificate

Certificate of Calibration

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

Certificate No : 22-AFM-140  
Request No : Req-2022-1607

Unit Under Calibration Details

Measurement Item Air Flow meter  
Manufacturer BGI  
Model Delta Cal DC1  
Serial Number : 159822  
ID : UAF:EFM.0392561  
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 : 22 August 2022  
Calibration Date : 7 September 2022

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 High Flow	18501012012	Sensidyne	15 June 2023

Traceability :

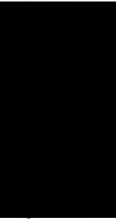
This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of

Units (SI)

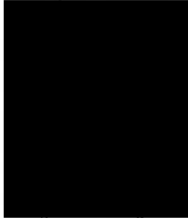
Note :

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

Calibration By :



Approved By



Issue Date

Customer

Name

Address

: UNITED ANALYST AND ENGINEERING CONSULTANT

: CO., LTD.

: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong,

Certificate No : 22-TPM-379

Request No : Req-2022-1607

Page : 1/2

Calibration Note

UUC Adjustment

: Not Adjust

Certificate No : 22-TPM-379

Request No : Req-2022-1607

Page : 2/2

Unit Under Calibration Details

Calibration Parameter : Temperature

Instrument Name : Air Flow meter

Manufacturer : BGI

Model : Delta Cal DCI

Serial Number : 159822

Resolution : 0.1 °C

ID Number : UAE.EFM.039/2561

Range Calibration : 20 °C to 45 °C

Type of Sensor : RTD

Sensor Diameter (mm) : 3

Calibration Position (mm) : 45

Instrument Status : Used

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (±°C)
Ta	20.004	20.0	0.0	0.14
	25.003	24.9	+0.1	0.14
	30.001	30.0	0.0	0.14
	35.002	34.9	+0.1	0.14
	40.002	39.8	+0.2	0.14
	45.005	45.0	0.0	0.14
Tf	20.004	20.1	-0.1	0.14
	25.003	24.9	+0.1	0.14
	30.001	29.9	+0.1	0.14
	35.002	34.9	+0.1	0.14
	40.002	39.9	+0.1	0.14
	45.005	45.2	-0.2	0.14


Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGOINGINGO, Model: GT11/RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 10 March 2022, Calibration Certificate No. : QR22-0578

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 %.

End of Certificate

Calibrated By : 

Mr. Noppadon Luangart

Approved By

Issue Date :

Approved By

Issue Date :

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.

PM-708-TPM-01 Rev.01 Issue date 13/02/20

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.

PM-708-TPM-01 Rev.01 Issue date 13/02/20



Cert.No.: 22P2728  
Page: 2 of 2

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

Range: 960 hPa to 1030 hPa

Scale Interval: 1 hPa ( The Fifth Estimate )

Applied Pressure (hPa)	956.27	967.46	978.89	989.55	999.85	1009.89	1020.55	1031.06
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	3.73	2.54	1.11	0.44	0.15	0.11	-0.55	-1.06

Decreasing Pressure

Applied Pressure (hPa)	1031.19	1020.73	1009.91	999.92	989.72	979.13	967.71	956.64
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.19	-0.73	0.09	0.08	0.28	0.87	2.29	3.36

The uncertainty of measurement was  $\pm 0.30$  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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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MSC758-7187053  
CALIBRATION 0028

## Certificate of Calibration

Certificate No.: 22P2728  
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: 20 July 2022

Calibration Date: 22 July 2022

Reference: 2207-0584WSC

Ambient Temperature: ( 23  $\pm$  2 ) °C

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

Atmospheric Pressure: 1010 mbar

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,  
Phra Khanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument

1) Standard Barometer

Model

Serial No.

Certificate No.

Due Date

DPI142

1422505046

MP-0076-22

02 May 2023

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 at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussanee  
Issue Date : 25 July 2022

Approved Signatory :

เอกสารแนบฉบับที่  
a 1118529

เอกสารแนบฉบับที่  
B 0293209



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
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MSC-181-1817625  
CALIBRATION 0088

Cert. No.: 22H1588  
Page.: 2 of 2

## Certificate of Calibration

Certificate No.: 22H1588  
Page : 1 of 2

### Result of Calibration:-

Function:

Humidity measurement.

Before Adjustment

Reference Temperature	Standard Humidity	UUC*	Error	Uncertainty of Measurement
(°C)	(%R.H.)	Reading (%R.H.)	(%R.H.)	(±%R.H.)
25.0	40.1	36	-4.1	1.6
25.0	60.0	50	-10.0	1.8
25.0	80.0	67	-13.0	2.0

### Result of Calibration:-

Function:

Humidity measurement.

After Adjustment

Reference Temperature	Standard Humidity	UUC*	Error	Uncertainty of Measurement
(°C)	(%R.H.)	Reading (%R.H.)	(%R.H.)	(±%R.H.)
25.0	40.1	42	1.9	1.6
25.0	60.0	60	0.0	1.8
25.0	80.0	76	-4.0	2.0

### Result of Calibration:-

Function:

Temperature measurement.

Without Adjustment

Reference Temperature	Standard Temperature	UUC*	Error	Uncertainty of Measurement
(°C)	(°C)	Reading (°C)	(°C)	(±°C)
20.04	20.04	20.5	0.46	0.72
24.98	24.98	25.0	0.02	0.72
30.01	30.01	30.0	-0.01	0.72
35.02	35.02	34.5	-0.52	0.72
40.02	40.02	39.5	-0.52	0.72

UUC\* : Unit Under Calibration

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

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Equipment : Dial Thermo-Hygrometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: UAE-ANY.131/2550

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022

Reference: 2207-0586WSC

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,  
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) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	19714	17 Sep 2022
2) Standard Humidity/Temperature Meter	400	10240757	TH-0125-21	13 Dec 2022

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 at:-

-National Institute of Standards and Technology (NIST) , The United States of America

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Somchai Dumwor  
Issue Date : 03 August 2022

Approved Signatory

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a 1119772

เอกสารไม่ควบคุม  
B 0293724

**MULTI-POINT GAS TEST REPORT**

Test Date : June 21, 2022

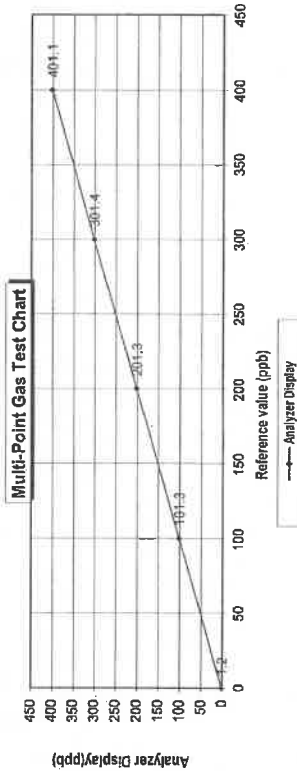
Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : 1182920007

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM Manufacturer : Thermo Scientific  
Nitric Oxide (NO) 45.35 PPM Model : 146i  
Methane (CH<sub>4</sub>) - PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Multi-point gas test data**

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	1.20	1.20	1.20
Level 2 20.00%	101.3	1.30	1.28	1.28
Level 3 40.00%	201.3	1.30	0.65	0.65
Level 4 60.00%	301.4	1.40	0.46	0.46
Level 5 80.00%	401.1	1.10	0.27	0.27
Average Difference (%)				0.77

Remark : Measuring Range 500.0 ppb  
Acceptable Limit  $\pm$  5%



**MULTI-POINT GAS TEST REPORT**

Test Date : Jun 27, 2022

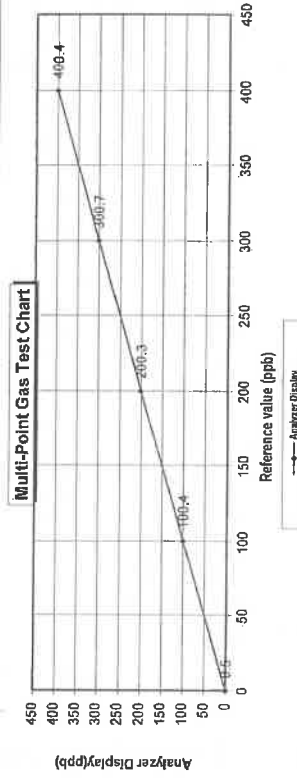
Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : 1180540062

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM Manufacturer : Thermo Scientific  
Nitric Oxide (NO) 45.35 PPM Model : 146i  
Methane (CH<sub>4</sub>) - PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Multi-point gas test data**

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.50	0.50	0.50
Level 2 20.00%	100.0	0.40	0.40	0.40
Level 3 40.00%	200.0	0.30	0.15	0.15
Level 4 60.00%	300.0	0.70	0.23	0.23
Level 5 80.00%	400.0	0.40	0.10	0.10
Average Difference (%)				0.28

Remark : Measuring Range 500.0 ppb  
Acceptable Limit  $\pm$  5%





### MULTI-POINT GAS TEST REPORT

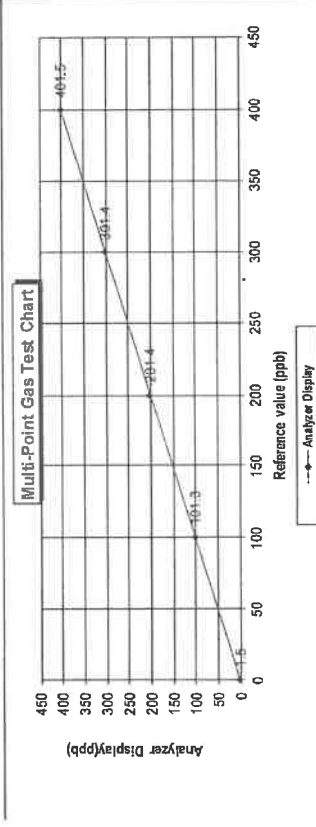
Test Date : June 23, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 421  
Manufacturer : Thermo Scientific Serial Number : 1191503036

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM Manufacturer : Thermo Scientific  
Nitric Oxide (NO) 45.35 PPM Model : 146i  
Methane (CH<sub>4</sub>) 1007 PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 1007  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	1.5	1.50	1.50	1.50
Level 2 20.00%	101.3	1.30	1.28	1.28
Level 3 40.00%	201.4	1.40	0.70	0.70
Level 4 60.00%	301.4	1.40	0.46	0.46
Level 5 80.00%	401.5	1.50	0.37	0.37
Remark : Measuring Range 500.0 ppb				
Acceptable Limit $\pm 5\%$				
Average Difference (%) 0.86				



### MULTI-POINT GAS TEST REPORT

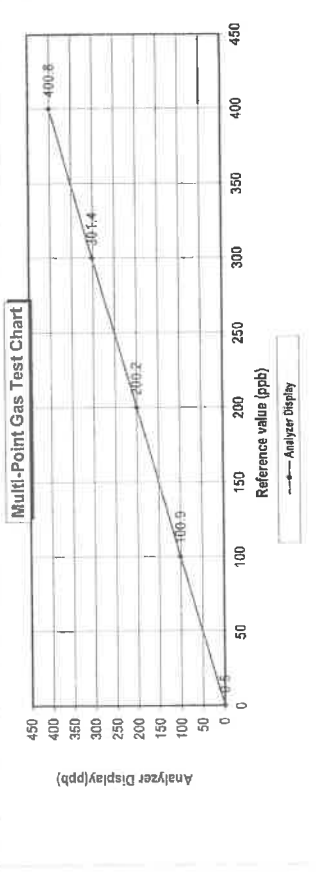
Test Date : Oct 17, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 421  
Manufacturer : Thermo Scientific Serial Number : 1182920009

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM Manufacturer : Thermo Scientific  
Nitric Oxide (NO) 45.94 PPM Model : 146i  
Methane (CH<sub>4</sub>) 984.8 PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 984.8  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.5	0.50	0.50	0.50
Level 2 20.00%	100.9	0.90	0.89	0.89
Level 3 40.00%	200.2	0.20	0.10	0.10
Level 4 60.00%	301.4	1.40	0.46	0.46
Level 5 80.00%	400.8	0.80	0.20	0.20
Remark : Measuring Range 500.0 ppb				
Acceptable Limit $\pm 5\%$				
Average Difference (%) 0.43				



# MULTI-POINT GAS TEST REPORT

Test Date : Oct 10, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>)  
Manufacturer : Thermo Scientific  
Model : 42i  
Serial Number : 1201497725

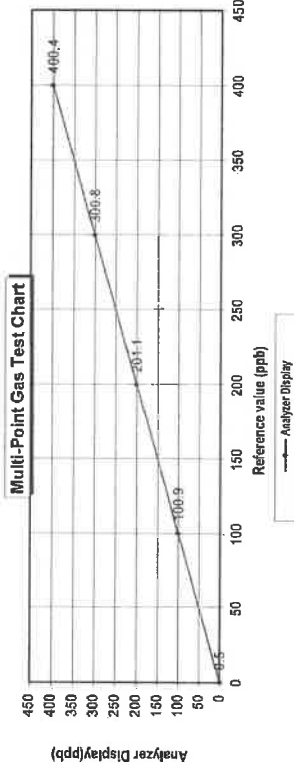
**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

**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	0.5	0.50	0.50	0.50
Level 2 20.00%	100.9	0.90	0.89	0.89
Level 3 40.00%	201.1	1.10	0.55	0.55
Level 4 60.00%	300.8	0.80	0.27	0.27
Level 5 80.00%	400.4	0.40	0.10	0.10
Average Difference (%)				0.46

Remark : Measuring Range 500.0 ppb  
Acceptable Limit  $\pm$  5%



# MULTI-POINT GAS TEST REPORT

Test Date : Oct 19, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>)  
Manufacturer : Thermo Scientific  
Model : 42i  
Serial Number : 1191503038

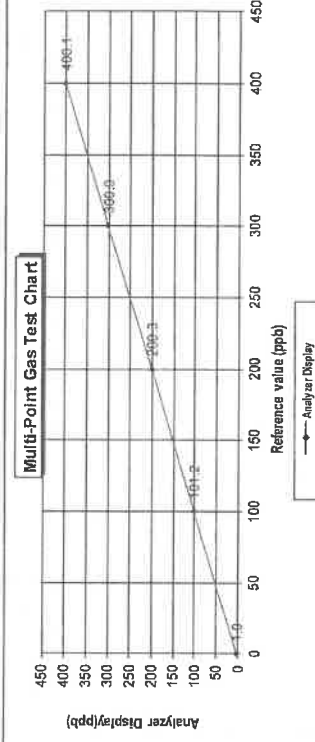
**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 984.8 PPM  
Cylinder No. : EB0143262  
Expiration Date : Jun 24, 2024

**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	1.0	1.00	1.00	1.00
Level 2 20.00%	101.2	1.20	1.19	1.19
Level 3 40.00%	200.3	0.30	0.15	0.15
Level 4 60.00%	300.9	0.90	0.30	0.30
Level 5 80.00%	400.1	0.10	0.02	0.02
Average Difference (%)				0.53

Remark : Measuring Range 500.0 ppb  
Acceptable Limit  $\pm$  5%



## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E16A01D3  
Cylinder Number: EB0143282  
Laboratory: 124 - Durham (SAP) - NC  
PGVP Number: B22021  
Gas Code: CO, NO, NOX, SO2, BALN  
Reference Number: 122-402135187-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 680  
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-12/21, 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 methane basis unless otherwise noted.

Do Not Use This Cylinder Below 100 ppb, 15, 0.7 megapascals.

#### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
NOX	45.00 PPM	46.96 PPM	G1	+/- 1.4% NIST Traceable	08/14/2021, 08/21/2021
NITRIC OXIDE	45.00 PPM	46.94 PPM	G1	+/- 1.4% NIST Traceable	08/14/2021, 08/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	08/14/2021, 08/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	08/14/2021
NITROGEN	Balance				

#### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC708088	48.02 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12388	D885025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	40142338102	CC505581	4.945 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1%	Feb 18, 2023
NTRM	16011043	CC473277	48.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	980.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 16, 2025

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

#### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 8700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 8700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 8700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 8700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

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



เอกสารไม่ควบคุม

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

#### MULTI-POINT GAS TEST REPORT

Test Date : June 30, 2022

Equipment : Gas Analyzer (NO2) Model : 421  
Manufacturer : Thermo Scientific Serial Number : 1201778105

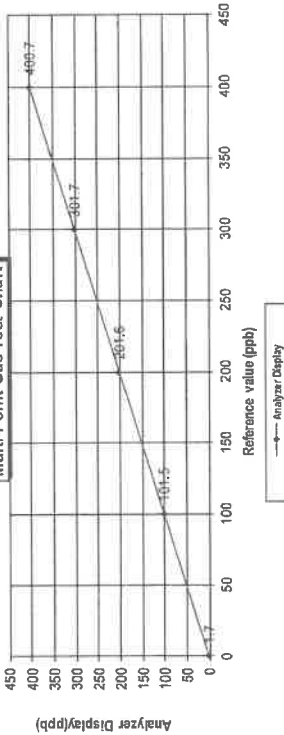
#### Standard Gas Concentration

Sulphur Dioxide (SO2) 44.75 PPM Manufacturer : Thermo Scientific  
Nitric Oxide (NO) 45.35 PPM Model : 1461  
Methane (CH4) - PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

#### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	1.70	1.70	1.70
Level 2	20.00%	100.0	101.5	1.50	1.48
Level 3	40.00%	200.0	201.6	1.60	0.79
Level 4	60.00%	300.0	301.7	1.70	0.56
Level 5	80.00%	400.0	400.7	0.70	0.17
Remark : Measuring Range 500.0 ppb			Average Difference (%)		
: Acceptable Limit $\pm 5\%$			0.94		

#### Multi-Point Gas Test Chart



# MULTI-POINT GAS TEST REPORT

Test Date : Oct 17, 2022

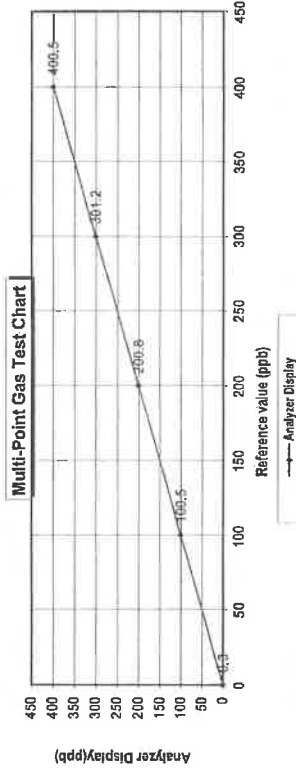
Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo SCIENTIFIC Serial Number : 43C-0607415779

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) 984.8 PPM  
Carbon Monoxide (CO) 984.8 PPM  
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	0.3	0.30	0.30
Level 2 20.00%	100.0	100.5	0.50	0.50
Level 3 40.00%	200.0	200.8	0.80	0.40
Level 4 60.00%	300.0	301.2	1.20	0.40
Level 5 80.00%	400.0	400.5	0.50	0.12
Measuring Range		500.0 ppb		
Acceptable Limit $\pm$ 5%		Average Difference (%)		
		0.34		



# MULTI-POINT GAS TEST REPORT

Test Date : Oct 18, 2022

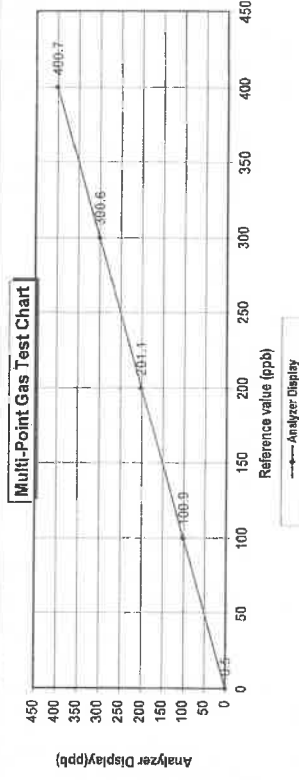
Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo SCIENTIFIC Serial Number : 43C-0607415779

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) 984.8 PPM  
Carbon Monoxide (CO) 984.8 PPM  
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	0.5	0.50	0.50
Level 2 20.00%	100.0	100.9	0.90	0.89
Level 3 40.00%	200.0	201.1	1.10	0.55
Level 4 60.00%	300.0	300.6	0.60	0.20
Level 5 80.00%	400.0	400.7	0.70	0.17
Measuring Range		500.0 ppb		
Acceptable Limit $\pm$ 5%		Average Difference (%)		
		0.46		



### Multi-Point Gas Test Report

Test Date : May 3, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 431  
Manufacturer : Thermo SCIENTIFIC Serial Number : 1201778111

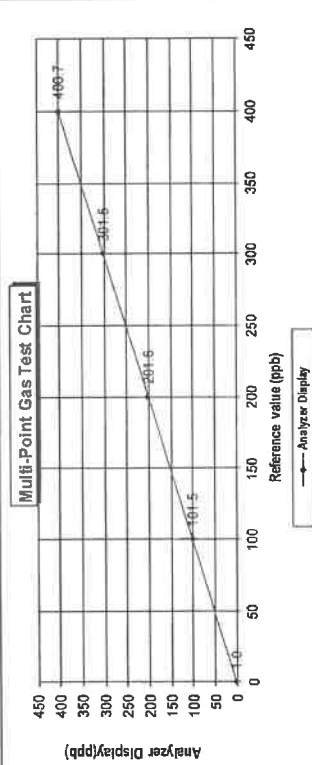
#### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM Manufacturer : Thermo SCIENTIFIC  
Nitric Oxide (NO) 45.35 PPM Model : 1461  
Methane (CH<sub>4</sub>) - PPM Serial Number : 11805-40071  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CCI59599  
Expiration Date : Jul 30, 2022

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	1.00	1.00	1.00
Level 2 20.00%	100.0	101.5	1.48	1.48
Level 3 40.00%	200.0	201.6	0.79	0.79
Level 4 60.00%	300.0	301.5	0.50	0.50
Level 5 80.00%	400.0	400.7	0.17	0.17
Average Difference (%)				0.79

Remark : Measuring Range 500.0 ppb  
Acceptable Limit  $\pm 5\%$



### Multi-Point Gas Test Report

Test Date : May 3, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 431  
Manufacturer : Thermo SCIENTIFIC Serial Number : 1200906876

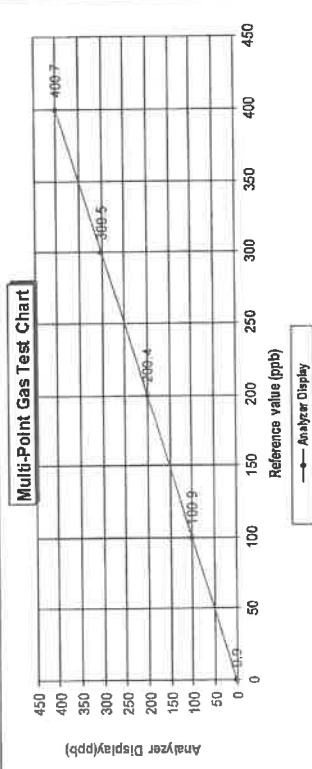
#### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM Manufacturer : Thermo SCIENTIFIC  
Nitric Oxide (NO) 45.35 PPM Model : 1461  
Methane (CH<sub>4</sub>) - PPM Serial Number : 11805-40071  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CCI59599  
Expiration Date : Jul 30, 2022

#### Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.90	0.90	0.90
Level 2 20.00%	100.0	100.9	0.90	0.89
Level 3 40.00%	200.0	200.4	0.40	0.20
Level 4 60.00%	300.0	300.5	0.50	0.17
Level 5 80.00%	400.0	400.7	0.70	0.17
Average Difference (%)				0.47

Remark : Measuring Range 500.0 ppb  
Acceptable Limit  $\pm 5\%$



**MULTI-POINT GAS TEST REPORT**

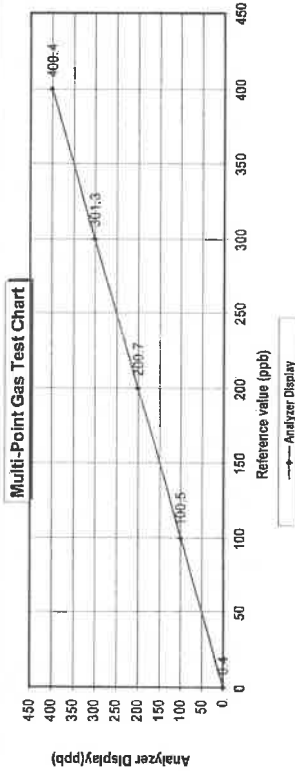
Test Date : Oct 20, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 431  
Manufacturer : Thermo SCIENTIFIC Serial Number : 1182920013

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM Manufacturer : Thermo SCIENTIFIC  
Nitric Oxide (NO) 45.94 PPM Model : 146i  
Methane (CH<sub>4</sub>) - PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 984.8  
Cylinder No. : E80143262  
Expiration Date : Jun 24, 2024

**Multi-point gas test data**

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	% Error
Level 1 Zero	0.0	0.4	0.40	0.40
Level 2 20.00%	100.0	100.5	0.50	0.50
Level 3 40.00%	200.0	200.7	0.70	0.35
Level 4 60.00%	300.0	301.3	1.30	0.43
Level 5 80.00%	400.0	400.4	0.40	0.10
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
Acceptable Limit $\pm 5\%$		0.36		



**MULTI-POINT GAS TEST REPORT**

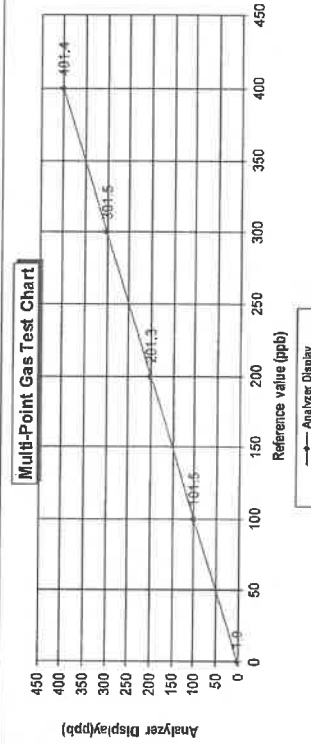
Test Date : May 3, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 431  
Manufacturer : Thermo SCIENTIFIC Serial Number : 120178113

**Standard Gas Concentration**  
Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM Manufacturer : Thermo SCIENTIFIC  
Nitric Oxide (NO) 45.35 PPM Model : 146i  
Methane (CH<sub>4</sub>) - PPM Serial Number : 1180540071  
Carbon Monoxide (CO) 1007  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Multi-point gas test data**

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	% Error
Level 1 Zero	0.0	1.9	1.90	1.90
Level 2 20.00%	100.0	101.5	1.50	1.48
Level 3 40.00%	200.0	201.3	1.30	0.65
Level 4 60.00%	300.0	301.5	1.50	0.50
Level 5 80.00%	400.0	401.4	1.40	0.35
Remark : Measuring Range 500.0 ppb		Average Difference (%)		
Acceptable Limit $\pm 5\%$		0.97		





United Analyst and Engineering Consultant Co., Ltd.  
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Tel. 0 2763 2828 Fax. 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com



Airgas Specialty Gases  
Airgas USA, LLC  
630 United Drive  
Ducham, NC 27723  
Airgas.com

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: ED4N199E16A01D3  
Cylinder Number: EB0143262  
Laboratory: 124 - Durham (SAP) - NC  
PGVP Number: B22021  
Gas Code: CO, NO, NOX, SO2, BALN  
Reference Number: 122-402135167-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
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 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	45.00 PPM	45.06 PPM	G1	+/- 1.4% NIST Traceable
NITRIC OXIDE	45.00 PPM	45.04 PPM	G1	+/- 1.4% NIST Traceable
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable
CARBON MONOXIDE	1000 PPM	994.8 PPM	G1	+/- 0.7% NIST Traceable
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	20081120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%
PRM	12386	DB85025	9.81 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%
GMS	401423634/02	CC509581	4.94 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1
NTRM	16011043	CC473277	48.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%
NTRM	14060118	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%
The SRM, PRM or RGM noted above is only in reference to the GMS used in the assay and not part of the analysis.				
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle			
Nicolet 6700 AHR0801333 CO	FTIR			
Nicolet 6700 AHR0801333 NO	FTIR			
Nicolet 6700 AHR0801333 NO2	FTIR			
Nicolet 6700 AHR0801333 SO2	FTIR			

Third Data Available Upon Request

NOTES: PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



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The analytical test results reported on this certificate relate only to the cylinder and does not include the test report.

### MULTI-POINT GAS TEST REPORT

Test Date : Oct 12, 2022

Equipment : Gas Analyzer (SO<sub>2</sub>)  
Manufacturer : Thermo SCIENTIFIC

Model : 43i  
Serial Number : 1182920017

#### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.68 PPM  
Nitric Oxide (NO) 45.94 PPM  
Methane (CH<sub>4</sub>) 984.8 PPM  
Carbon Monoxide (CO) 980.143262 PPM  
Cylinder No. : E90143262  
Expiration Date : Jun 24, 2024

#### Dilutor Detail

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

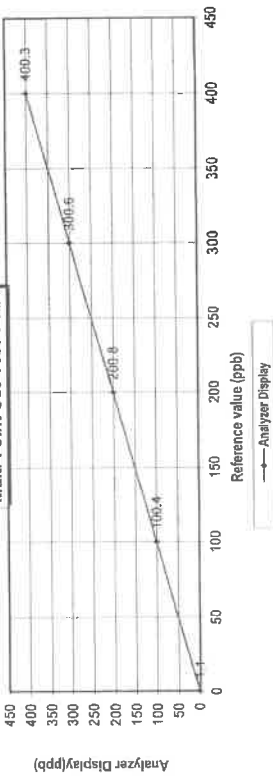
#### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	% Error
Level 1	Zero	1.1	1.10	1.10	1.10
Level 2	20.00%	100.4	0.40	0.40	0.40
Level 3	40.00%	200.8	0.80	0.40	0.40
Level 4	60.00%	300.6	0.60	0.20	0.20
Level 5	80.00%	400.3	0.30	0.07	0.07

Remark : Measuring Range 500.0 ppb

Acceptable Limit  $\pm 5\%$

#### Multi-Point Gas Test Chart





## The Result of Calibration

Certification No. 275/22

2 August, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure inches H <sub>2</sub> O	Vacuum inches H <sub>2</sub> O	Velocity m/sec	Correction m/sec
1.00	-	-	1.0	0.00
3.02	-	-	3.0	0.02
5.00	-	-	4.9	0.10
7.04	-	-	6.8	0.24
9.02	-	-	8.8	0.22
11.01	-	-	10.7	0.31
13.01	-	-	12.7	0.31
15.01	-	-	14.6	0.41
17.02	-	-	16.6	0.42
20.02	-	-	19.5	0.52

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. Watchapol Subwat

Mechanical Engineer



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## Calibration Certificate

Issued by : Calibration &amp; Test Section : Meteorological Instruments Bureau

Date of Issue : 2 August, 2022

Certification No. 275/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : 20040002 wind speed and wind direction 20040162  
ID No. : No.2/20

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 1007.7 hPa

## NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated by

Mr. Watchapol

Mechanical



เอกสารไม่ควบคุม





## The Result of Calibration

Certification No. 259/22

12 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure Inches H2O	Vacuum Inches H2O	Velocity m/sec	Correction m/sec
1.00	-	-	0.6	0.40
3.02	-	-	2.4	0.62
5.00	-	-	4.1	0.90
7.04	-	-	6.4	0.64
9.02	-	-	8.1	0.92
11.01	-	-	10.4	0.61
13.01	-	-	12.5	0.51
15.01	-	-	14.7	0.31
17.02	-	-	16.5	0.52
20.02	-	-	19.7	0.32

Wind Aloft Plotting Board.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by

Mr. Watchapol Subwat  
Mechanical Engineer

## Calibration Certificate

Issued by : Calibration &amp; Test Section : Meteorological Instruments Bureau

Date of Issue : 12 July, 2022 Certification No. 259/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : Data Logger 20040005 wind speed and wind direction 20040164  
ID No. : No.4/20

Customer : United Analyst and Engineering Consultant Co.,Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Prakenong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1006.4 hPa

NATIONAL STANDARD WIND TUNNEL

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pilot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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 120629566)

JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated  
Mr. Wat  
Mechan

เอกสารไม่ควบคุม



## The Result of Calibration

Certification No. 262/22

12 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure Inches H <sub>2</sub> O	Vacuum Inches H <sub>2</sub> O	Velocity m/sec	Correction m/sec
1.00	-	-	0.7	0.30
3.02	-	-	2.5	0.52
5.00	-	-	4.2	0.80
7.04	-	-	6.7	0.34
9.02	-	-	8.7	0.32
11.01	-	-	10.5	0.51
13.01	-	-	12.7	0.31
15.01	-	-	14.3	0.71
17.02	-	-	16.7	0.32
20.02	-	-	19.3	0.72

Wind Aloft Plotting Board.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by

Mr. Wacharapong Suwatt  
Mechanical Engineer



กรมอุตุนิยมวิทยา  
THAI METEOROLOGICAL DEPARTMENT  
Calibration & Test Section  
Meteorological Instruments Bureau  
เอกสารถ่ายแบบ



## Calibration Certificate

Issued by : Calibration &amp; Test Section : Meteorological Instruments Bureau

Date of Issue : 12 July, 2022

Certification No. 202/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : Data Logger 20080022 wind speed and wind direction 20050136  
ID No. : No.20/20

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 1003.5 hPa

## NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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

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

Serial Number 110730029 (sensor 120629596)

JAPAN



Calibrated  
Mr. Wacharapong Suwatt  
Mechanical Engineer

กรมอุตุนิยมวิทยา  
THAI METEOROLOGICAL DEPARTMENT  
Calibration & Test Section  
Meteorological Instruments Bureau  
เอกสารถ่ายแบบ



## The Result of Calibration

Certification No. 261/22

12 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure Inches H <sub>2</sub> O	Vacuum Inches H <sub>2</sub> O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.8	0.20
3.02	-	-	-	2.6	0.42
5.00	-	-	-	4.3	0.70
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.7	0.32
11.01	-	-	-	10.5	0.51
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.9	0.11
17.02	-	-	-	16.7	0.32
20.02	-	-	-	19.8	0.22

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 Suwatt

Mechanical Engineer



เอกสารไม่ควบคุม



## Calibration Certificate

Issued by : Calibration &amp; Test Section : Meteorological Instruments Bureau

Date of issue 12 July, 2022 Certification No. 261/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : Data Logger 20040026 wind speed and wind direction 20040177  
ID No. : No.7/20

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 1004.3 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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 120629686)

JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated by

Mr. Watcharapol Suwatt

Mechanical Engineer



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## Calibration Certificate

## The Result of Calibration

Certification No. 276/22

2 August, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure inches H <sub>2</sub> O	Vacuum inches H <sub>2</sub> O	Velocity m/sec	Correction m/sec
1.00	-	-	1.0	0.00
3.02	-	-	3.0	0.02
5.00	-	-	5.0	0.00
7.04	-	-	6.9	0.14
9.02	-	-	8.9	0.12
11.01	-	-	10.9	0.11
13.01	-	-	12.9	0.11
15.01	-	-	14.8	0.21
17.02	-	-	16.8	0.22
20.02	-	-	19.8	0.22

Wind Aloft Plotting Board.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated

Mr. Wacharapoi Subwat  
Mechanical Engineer



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เอกสารไมศวนคุณ

Issued by : Calibration &amp; Test Section : Meteorological Instruments Bureau

Date of Issue : 2 August, 2022

Certification No. 276/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : Data Logger 20080020 wind speed and wind direction 20040192

ID No. : No.18/20

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

81 Sol Udornsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1006.9 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pilot Tube Theodor Friedrichs Type 0900.0000 serial 9023

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 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

Standard Velocity at 20 m/sec

Calibrated by

Mr. Wacharapoi

Mechanical



เอกสารไมศวนคุณ  
เอกสารไมศวนคุณ



# THAI METEOROLOGICAL DEPARTMENT

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



# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

## The Result of Calibration

Certification No. 263/22

14 July, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
	-	-	-	-	-
1.00	-	-	-	0.95	0.05
3.02	-	-	-	2.94	0.08
5.00	-	-	-	4.94	0.06
7.04	-	-	-	6.98	0.06
9.02	-	-	-	8.93	0.09
11.01	-	-	-	10.92	0.09
13.01	-	-	-	12.92	0.09
15.01	-	-	-	15.02	-0.01
17.02	-	-	-	17.01	0.01
20.02	-	-	-	20.16	-0.14

Wind Aloft Plotting Board.		
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU		
WIND DIRECTION	TESTED WIND DIRECTION	
0	0	0
90	90	90
180	180	180
270	270	270

Calibrated by :

Mr. Watchapol Subwat  
Mechanical Engineer



เอกสารไม่ควบคุม

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 14 July, 2022

Certification No. 263/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Sensor YOUNG

Basic Datalogger : NRG

Type : Sensor : 05103-45 Basic Datalogger : LR20

Serial No. : Sensor : 97947 Basic Datalogger : 30905375

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 1004.8 hPa

NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

: HOOK GAGE NO 1425 Pilot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 20 - 30 m/sec

Calibrated by :

Mr. Watchapol  
Mechanical Engineer



เอกสารไม่ควบคุม



7. Long Term Stability

UUC Setting	Measured		Acceptance Limit (± dB)
	UUC (dB)	UNCERTAINTY (± dB)	
FAST / A / 37-139			
STD Setting			
Initial	114.0		
Final	114.0		
Deviated	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated		Deviation	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
	REF (dB)	UUC (dB)			
FAST / A / 37-139					
STD dB					
140.00	140	140.0	0.0		1.1
139.00	139	139.0	0.0		1.1
134.00	134	134.0	0.0		1.1
129.00	129	129.0	0.0		1.1
124.00	124	124.0	0.0		1.1
119.00	119	119.0	0.0		1.1
114.00	114	114.0	0.0		1.1
109.00	109	109.0	0.0		1.1
104.00	104	104.0	0.0		1.1
99.00	99	99.0	0.0		1.1
94.00	94	94.0	0.0		1.1
89.00	89	89.0	0.0		1.1
84.00	84	84.0	0.0		1.1
79.00	79	79.0	0.0		1.1
74.00	74	74.0	0.0		1.1
69.00	69	69.0	0.0		1.1
64.00	64	64.0	0.0		1.1
59.00	59	59.0	0.0		1.1
54.00	54	54.0	0.0		1.1
49.00	49	49.0	0.0		1.1
44.00	44	44.1	0.1		1.1
39.00	39	39.3	0.3		1.1

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

UUC Setting		Deviation from various Frequency				UNCERTAINTY (± dB)	Acceptance Limit (± dB)
	FAST / 37-139	Weighting Response curve					
	STD Setting	A (dB)	C (dB)	Z (dB)			
	63 Hz	-0.2	0.0	0.0	0.2	2.0	
	125 Hz	-0.1	0.0	0.0		1.5	
	250 Hz	-0.1	0.0	0.0		1.5	
	500 Hz	-0.1	0.0	0.0		1.5	
	1000 Hz	0.0	0.0	0.0		1.0	
	2000 Hz	0.0	0.1	0.0		2.0	
	4000 Hz	0.0	0.0	0.0		3.0	
	8000 Hz	0.0	0.0	0.0		5.0	
	16000 Hz	-0.1	-0.1	-0.1		+5, -INF.	

6. Frequency and time weightings at 1kHz

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

UUC Setting	STD REF (dB)	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)		
37-139 / A					
UUC Time Response					
Fast	114.00	114.0	0.0		0.1
Slow	114.00	114.0	0.0	0.2	0.1
Leq	114.00	114.0	0.0		0.1

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

PM-708-SLM-01 Rev.0 Issue date 01/07/15

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PM-708-SLM-01 Rev.0 Issue date 01/07/15

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Certificate No : 22-ACT-104  
Request No : Req-2022-0232

12. Overload indication

UUC Setting	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A / 37-139	UUC (dB)		
STD Setting			
Positive one-half cycle	142.7		
Negative one-half cycle	142.6		
Deviated	0.1	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A / 37-139	UUC (dB)		
STD Setting			
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

End of Certificate

Certificate No : 22-ACT-104  
Request No : Req-2022-0232

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A	REF (dB)	UUC (dB)	ERR (dB)	
UUC Range				
	44.1	43.7	-0.4	1.1
37-139	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
A / 37-139	Toneburst (ms)	Ref (dB)	UUC (dB)	ERR (dB)	
UUC Time Response					
	200	135.0	135.0	0.0	1.0
Fast	2	118.0	117.9	-0.1	+1.0, -2.5
	0.25	109.0	108.7	-0.3	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1.0
	2	109.0	108.8	-0.2	+1.0, -5.0
	200	129.0	129.0	0.0	1.0
SEL	2	109.0	109.1	+0.1	+1.0, -2.5
	0.25	100.0	99.7	-0.3	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / C / 95-142	REF (dB)	UUC (dB)	ERR (dB)	
STD Setting				
Complete cycle	137.4	136.7	-0.70	3.0
Positive half cycle	136.4	136.2	-0.20	2.0
Negative half cycle	136.4	136.2	-0.20	2.0



Certificate of Calibration

Customer

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

Certificate No : 22-ACT-102  
Request No : Req-2022-0233

Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : LxT2  
Serial Number : 0006615  
ID : UAE.EFM.0462564  
Resolution : 0.1 dB  
Calibration Environment and Details  
Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 31 January 2022  
Calibrated Date : 11 February 2022  
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 : Die calibration : Traceability  
Standard Microphone : GRAS : 40AN : 188273 : 15 September 2022 : GRAS  
Multifrequency Calibrator : Quest : Quest-cal : EFA000234 : 14 June 2022 : TSI  
Audio Generator : Svaniek : Svan401 : 131 : 18 October 2022 : 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 Luangrat  
Calibration Officer

Approved By : 

Mr. Pait Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 11 February 2022

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

PM-708-SLM-01 Rev.0 Issue date 01/07/15

เอกสารไม่ควบคุม

Certificate No : 22-ACT-102  
Request No : Req-2022-0233

1. Indication at the calibration check frequency									
UUC Setting	Nominal		Before Adjust		Adjust		UNCERTAINTY		Acceptance Limit
	Level	(dB)	UUC	ERR	UUC	ERR	(± dB)	(± dB)	(± dB)
Calibrator Setting									
1000 Hz 114.00 dB	113.85		113.9	+0.05	113.9	0.05	0.20		0.3
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			
UUC Weighting	(dB)	(± dB)	
A	27.8	0.10	

3. Self-generated noise, Microphone replaced by the electrical input signal device			
UUC Setting	Measured	UNCERTAINTY	
FAST / 37-139			
UUC Weighting	(dB)	(± dB)	
A	27.7	0.10	
C	27.5	0.10	
Z	34.0	0.10	

4. Acoustic signal test of frequency weightings (Without Windscreen)						
UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY		Acceptance Limit
	A	C	Z	(± dB)	(± dB)	(± dB)
FAST / 37-139						
STD Setting						
125 Hz	-0.1	0.1	0.1	0.50		2.0
1000 Hz	0.0	0.0	0.0	0.60		1.0
4000 Hz	0.5	0.5	0.6	0.60		3.0
8000 Hz	0.3	0.3	0.4	0.70		5.0

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

PM-708-SLM-01 Rev.0 Issue date 01/07/15

เอกสารไม่ควบคุม

Certificate No : 22-ACT-102  
Request No : Req-2022-0233

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 37-139	UUC (dB)		
STD Setting			
Initial	114.0		
Final	114.0		
Deviated	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A / 37-139	REF (dB)	UUC (dB)	ERR (dB)	Limit (± dB)
STD dB				
140.00	140	140.0	0.0	1.1
139.00	139	139.0	0.0	1.1
134.00	134	134.0	0.0	1.1
129.00	129	129.0	0.0	1.1
124.00	124	124.0	0.0	1.1
119.00	119	119.0	0.0	1.1
114.00	114	114.0	0.0	1.1
109.00	109	109.0	0.0	1.1
104.00	104	104.0	0.0	1.1
99.00	99	99.0	0.0	1.1
94.00	94	93.9	-0.1	1.1
89.00	89	88.9	-0.1	1.1
84.00	84	83.9	-0.1	1.1
79.00	79	78.9	-0.1	1.1
74.00	74	73.9	-0.1	1.1
69.00	69	68.9	-0.1	1.1
64.00	64	63.9	-0.1	1.1
59.00	59	58.9	-0.1	1.1
54.00	54	53.9	-0.1	1.1
49.00	49	48.9	-0.1	1.1
44.00	44	44.0	0.0	1.1
39.00	39	39.2	0.2	1.1
34.00	34	34.3	0.3	1.1

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd  
FM-708-SLM-01 Rev.0 Issue date 01/07/15

เอกสารไม่ควบคุม

Certificate No : 22-ACT-102  
Request No : Req-2022-0233

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

UUC Setting	Deviation From various Frequency	UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve	(± dB)	Limit (± dB)
STD Setting			
63 Hz	A (dB) C (dB) Z (dB)		2.0
125 Hz	-0.2 0.0 0.0		
250 Hz	-0.1 0.0 0.0		1.5
500 Hz	-0.1 0.0 0.0		1.5
1000 Hz	-0.1 0.0 0.0		1.5
2000 Hz	0.0 0.0 0.0	0.2	1.0
4000 Hz	0.0 0.0 0.0		2.0
8000 Hz	0.0 0.0 0.0		3.0
16000 Hz	0.0 0.0 0.0		5.0
	-0.1 -0.1 -0.1		+5, -INF.

6. Frequency and time weightings at 1kHz

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

UUC Setting	STD	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
	REF (dB)	UUC (dB)	ERR (dB)		
37-139 / A					
UUC Time Response					
Fast	114.00	114.0	0.0		0.1
Slow	114.00	114.0	0.0	0.2	0.1
Leq	114.00	114.0	0.0		0.1

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd  
FM-708-SLM-01 Rev.0 Issue date 01/07/15

เอกสารไม่ควบคุม

Certificate No : 22-ACT-102  
Request No : Req-2022-0233

9. Level linearity including the level range control

UUC Setting	STD REF (dB)	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)		
FAST / A					
UUC Range	43.2	42.9	-0.3		1.1
37-139	114	114.0	0.0	0.3	1.1

10. Tone burst response

UUC Setting	STD Toneburst (ms)	Anticipated Ref (dB)	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
			UUC (dB)	ERR (dB)		
A / 37-139						
UUC Time Response						
Fast	200	135.0	135.0	0.0		1.0
	2	118.0	117.8	-0.2		+1.0, -2.5
	0.25	109.0	108.6	-0.4		+1.5, -5.0
Slew	200	128.6	128.5	-0.1	0.3	1.0
	2	109.0	108.9	-0.1		+1.0, -5.0
	200	129.0	129.0	0.0		1.0
SEL	2	109.0	109.0	0.0		+1.0, -2.5
	0.25	100.0	99.8	-0.2		+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated REF (dB)	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)		
FAST / C / 95-142					
STD Setting					
Complete cycle	137.4	136.8	-0.60		3.0
Positive half cycle	136.4	136.2	-0.20	0.2	2.0
Negative half cycle	136.4	136.2	-0.20		2.0

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Certificate No : 22-ACT-102  
Request No : Req-2022-0233

12. Overload indication

UUC Setting	Measured UUC (dB)	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 37-139			
STD Setting			
Positive one-half cycle	141.7		
Negative one-half cycle	141.7		
Deviated	0.0	0.2	1.5

13. High Level Stability

UUC Setting	Measured UUC (dB)	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 37-139			
STD Setting			
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

End of Certificate

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FM-708-SLM-01 Rev.0 Issue date 01/07/15

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Certificate No : 22-ACT-113  
Request No : Req-2022-0330

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

UUC Setting	Deviation from various Frequency				UNCERTAINTY (± dB)	Acceptance Limit (± dB)
	FAST / 37-139	A (dB)	C (dB)	Z (dB)		
STD Setting						
63 Hz		-0.2	-0.1	-0.1		2.0
125 Hz		-0.1	0.0	-0.1		1.5
250 Hz		-0.1	-0.1	-0.1		1.5
500 Hz		-0.1	0.0	0.0		1.5
1000 Hz		0.0	0.0	0.0	0.2	1.0
2000 Hz		0.0	0.0	0.0		2.0
4000 Hz		0.0	0.0	0.0		3.0
8000 Hz		-0.1	-0.1	0.0		5.0
16000 Hz		-0.1	-0.1	-0.1		+5, -INF

6. Frequency and time weightings at 1kHz

UUC Setting	FAST / 37-139	UUC Weighting	Measured			UNCERTAINTY (± dB)	Acceptance Limit (± dB)
			STD	REF	ERR		
A			114.00	114.00	0.0		0.2
C			114.00	114.00	0.0	0.2	0.2
Z			114.00	114.00	0.0		0.2
UUC Setting	37-139 / A						
UUC Time Response							
Fast			114.00	114.00	0.0		0.1
Slow			114.00	114.00	0.0	0.2	0.1
Leq			114.00	114.00	0.0		0.1

Certificate No : 22-ACT-113  
Request No : Req-2022-0330

7. Long Term Stability

UUC Setting	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
	FAST / A / 37-139	UUC (dB)		
STD Setting				
Initial		114.0		
Final		114.0		
Deviated		0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	FAST / A / 37-139	STD dB	Anticipated REF (dB)	Deviation		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
				UUC (dB)	ERR (dB)		
139.00			139	139.0	0.0		1.1
134.00			134	134.0	0.0		1.1
129.00			129	129.0	0.0		1.1
124.00			124	124.0	0.0		1.1
119.00			119	119.0	0.0		1.1
114.00			114	114.0	0.0		1.1
109.00			109	109.0	0.0		1.1
104.00			104	104.0	0.0		1.1
99.00			99	99.0	0.0		1.1
94.00			94	93.9	-0.1		1.1
89.00			89	88.9	-0.1		1.1
84.00			84	83.9	-0.1	0.3	1.1
79.00			79	78.9	-0.1		1.1
74.00			74	73.9	-0.1		1.1
69.00			69	68.9	-0.1		1.1
64.00			64	63.9	-0.1		1.1
59.00			59	58.9	-0.1		1.1
54.00			54	53.9	-0.1		1.1
49.00			49	49.0	0.0		1.1
44.00			44	44.1	0.1		1.1
39.00			39	39.3	0.3		1.1
34.00			34	34.5	0.5		1.1

Certificate No : 22-ACT-113  
Request No : Req-2022-0330

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC (dB)	(± dB)	(± dB)
STD Setting			
Positive one-half cycle	141.9		
Negative one-half cycle	141.9		
Deviated	0.0	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC (dB)	(± dB)	(± dB)
STD Setting			
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

End of Certificate

Certificate No : 22-ACT-113  
Request No : Req-2022-0330

9. Level linearity including the level range control

UUC Setting	STD	REF	UUC	ERR	UNCERTAINTY	Acceptance Limit
FAST / A		(dB)	(dB)	(dB)	(± dB)	(± dB)
UUC Range						
	43.6		43.7	0.1		1.1
37-139	114		114.0	0.0	0.3	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance Limit
A / 37-139	Timeburst (ms)	Ref (dB)	UUC (dB)	ERR (dB)	(± dB)
UUC Time Response					
	200	135.0	135.0	0.0	1.0
Fast	2	118.0	117.6	-0.4	±1.0, -2.5
	0.25	109.0	108.6	-0.4	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1.0
	2	109.0	108.8	-0.2	+1.0, -5.0
SEL	200	129.0	129.0	0.0	1.0
	2	109.0	109.0	0.0	±1.0, -2.5
	0.25	100.0	99.8	-0.2	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance Limit
FAST / C / 95-142	REF	UUC	ERR	(± dB)
STD Setting	(dB)	(dB)	(dB)	(± dB)
Complete cycle	137.4	136.7	-0.70	3.0
Positive half cycle	136.4	136.2	-0.20	2.0
Negative half cycle	136.4	136.2	-0.20	2.0

Certificate of Calibration

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Certificate No : 22-ACT-100

Request No : Req-2022-0234

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1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	Adjust	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	Level	UUC	ERR	ERR	Limit
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(± dB)
1000 Hz 114.00 dB	113.85	+0.05	113.9	0.05	0.3

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	28.9	0.10

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	28.8	0.10
C	28.4	0.10
Z	34.3	0.10

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)
125 Hz	0.0 0.1 0.0	0.50	2.0
1000 Hz	0.0 0.0 0.0	0.60	1.0
4000 Hz	0.6 0.6 0.6	0.60	3.0
8000 Hz	0.5 0.5 0.6	0.70	5.0

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD. Certificate No : 22-ACT-100

Name : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok Request No : Req-2022-0234

Address : 10260

Unit Under Calibration Details

Measurement item : Sound Level Meter Microphone Class : 2

Manufacturer : LARSON DAVIS Microphone Model : 375A04

Model : LX72 Microphone SN : 328669

Serial Number : 0066617 Preamplifier Model : PRLMX12C

ID : UAE.EFM.04872564 Preamplifier SN : 071532

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 : 31 January 2022

Calibrated Date : 11 February 2022

Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-1 : 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	15 September 2022	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000214	14 June 2022	TSI
Audio Generator	Svanek	Svan401	131	18 October 2022	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. Picit Mathavorn Calibration Engineer Supervisor

Issue Date : 11 February 2022

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Certificate No	: 22-ACT-100
Request No	: Req-2022-023

Certificate No	:	22-ACT-100
Request No	:	Req-2022-02

## 7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-39	UUC	<div style="background-color: black; width: 100px; height: 100px; margin: 0 auto;"></div>	<div style="background-color: black; width: 100px; height: 100px; margin: 0 auto;"></div>
STD Setting	(dB)		
Initial	114.0		
Final	114.0		
Deviated	0.0	0.1	0.3

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

UUC Setting		Anticipated		Deviation		UNCERTAINTY (+ dB)	Acceptance Limit (± dB)
FAST / A / 37-139	STD dB	REF (dB)	UUC (dB)	ERR (dB)			
	140.00	140	140.0	0.0	0.3	1.1	
	139.00	139	139.0	0.0		1.1	
	134.00	134	134.0	0.0		1.1	
	129.00	129	129.0	0.0		1.1	
	124.00	124	124.0	0.0		1.1	
	119.00	119	119.0	0.0		1.1	
	114.00	114	114.0	0.0		1.1	
	109.00	109	109.0	0.0		1.1	
	104.00	104	104.0	0.0		1.1	
	99.00	99	99.0	0.0		1.1	
	94.00	94	94.0	0.0		1.1	
	89.00	89	89.0	0.0		1.1	
	84.00	84	84.0	0.0		1.1	
	79.00	79	79.0	0.0		1.1	
	74.00	74	74.0	0.0		1.1	
	69.00	69	69.0	0.0		1.1	
	64.00	64	64.0	0.0		1.1	
	59.00	59	59.0	0.0		1.1	
	54.00	54	54.0	0.0		1.1	
	49.00	49	49.0	0.0		1.1	
	44.00	44	44.1	0.1	1.1		
	39.00	39	39.4	0.4	1.1		

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

UUC Setting		Deviation from various Frequency				UNCERTAINTY		Acceptance	
FAST / 37-139		Weighting Response curve				Z (dB)	Limit (± dB)		
STD Setting	A (dB)	C (dB)	Z (dB)						
63 Hz	-0.2	0.0	0.0	0.0	0.2	2.0			Limit (± dB)
125 Hz	-0.1	0.0	0.0	0.0		1.5			
250 Hz	-0.1	0.0	0.0	0.0		1.5			
500 Hz	-0.1	0.0	0.0	0.0		1.5			
1000 Hz	0.0	0.0	0.0	0.0		1.0			
2000 Hz	0.0	0.1	0.0	0.0		2.0			
4000 Hz	0.0	0.0	0.0	0.0		3.0			
8000 Hz	-0.1	0.0	0.0	0.0		5			
16000 Hz	-0.1	-0.1	-0.1	-0.1	+5% - INF.				

## 6. Frequency and time weightings at 1kHz

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

UUC Setting	STD REF	Measured		UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
		UUC (dB)	ERR (dB)		
UUC Time Response	Fast	114.00	0.0	0.2	0.1
	Slow	114.00	0.0		0.1
	Leq	114.00	0.0		0.1

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## เอกสารไม่ควบคุม

# เอกสารไม่ควบคุม



## 12. Overload indication

12. OVERNOISE INDICATION	UUC Setting		Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
	FAST / A / 37-139		UUC (dB)		
	STD Setting				
	Positive one-half cycle		142.8		
	Negative one-half cycle		142.7		
	Deviated		0.1	0.2	1.5

### 13. High Level Stability

UUC Setting		Measured UUC (dB)	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A / 37-139				
STD Setting				
Initial		138.0		
Final		138.0		
Deviated		0.0	0.1	0.3

## End of Certificate

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

	UUC Setting		STD		Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
	FAST / A	UUC Range	REF (dB)	UUC (dB)	ERR (dB)			
			43.9	43.6	-0.3	0.3	1.1	
37-139		114	114.0	0.0	1.1			

## 10. Tone burst response

10. Tone Burst Response		STD Toneburst (ms)	Anticipated Ref (dB)	Measured		UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
UUC Setting				UUC (dB)	ERR (dB)		
UUC Time Response							
Fast	A / 37-139	200	135.0	134.9	-0.1	0.3	1.0
		2	118.0	117.6	-0.4		+1.0, -2.5
		0.25	109.0	108.7	-0.3		+1.5, -5.0
Slow		200	128.6	128.5	-0.1		1.0
		2	109.0	108.9	-0.1		+1.0, -5.0
SEL		200	129.0	129.0	0.0		1.0
		2	109.0	109.1	+0.1	+1.0, -2.5	
		0.25	100.0	99.9	-0.1	+1.5, -5.0	

### 11. Peak C Sound level

1.1. Peak C Sound Level		Anticipated REF (dB)	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
UUC Setting			UUC (dB)	ERR (dB)		
FAST / C / 95-142						
STD Setting						
Complete cycle		137.4	136.8	-0.60		3.0
Positive half cycle		136.4	136.2	-0.20	0.2	2.0
Negative half cycle		136.4	136.2	-0.20		2.0

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FM-708-SLM-01 Rev.0 Issue date 01/07/16

## เอกสารไม่ควบคุม

## เอกสารไม่ควบคุม

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to 1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20  $\mu$ Pa

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 2 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2021-09-10	2022-09-10	001250
Hart Scientific 2626-H Temperature Probe	2021-02-04	2022-08-04	006767
Larson Davis CAL200 Acoustic Calibrator	2021-07-21	2022-07-21	007027
Larson Davis Model 831	2022-02-21	2023-02-21	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2022-03-02	2023-03-02	007185
SRS DS360 Ultra Low Distortion Generator	2021-04-13	2022-04-13	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2021-09-28	2022-09-28	PCB0004783

### Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement Point	Test Result (dB)	Lower Limit (dB)	Upper Limit (dB)	Expanded Uncertainty (dB)	Pass/Fail
1000 Hz	114.01	113.80	114.20	0.14	Pass

### Loaded Circuit Sensitivity

Measurement Point	Test Result (dB re 1 V/1 Pa)	Lower Limit (dB re 1 V/1 Pa)	Upper Limit (dB re 1 V/1 Pa)	Expanded Uncertainty (dB)	Pass/Fail
1000 Hz	-50.78	-52.44	-48.33	0.14	Pass

— End of measurement results—

LARSON DAVIS - A PCB PIEZOTRONICS DIV.

1681 West 820 North  
Provo, UT 84601, United States  
716-684-0001



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D0001.8406 Rev F

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# Calibration Certificate

Certificate Number 2022003082

#### Customer:

United Analyst and Engineering Consultant Co Ltd  
No. 81 Soi Udonasuk 41, Sukhumvit Road,  
Bangchak, Phra Khanong,  
Bangkok, 10260, Thailand

**Model Number** LX12  
**Serial Number** 0006889  
**Test Results** Pass  
**Initial Condition** As Manufactured

**Procedure Number** D0001.8384  
**Technician** Jacob Cannon  
**Calibration Date** 11 Mar 2022  
**Calibration Due**  
**Temperature** 23.63 °C ± 0.25 °C  
**Humidity** 53.5 %RH ± 2.0 %RH  
**Static Pressure** 87.16 kPa ± 0.13 kPa

**Description**  
SoundTrack LxT Class 2  
Class 2 Sound Level Meter  
Firmware Revision: 2.404

#### Evaluation Method

Tested with:

PCB 375A04, S/N 335074  
Larson Davis CAL291, S/N 0708  
Larson Davis CAL200, S/N 9079  
Larson Davis PRMLxT2C, S/N 071570

Data reported in dB re 20  $\mu$ Pa.

#### Compliance Standards

Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

ANSI S1.4-2014 Class 2  
IEC 60651:2001 Type 2  
IEC 60804:2000 Type 2  
IEC 61252:2002  
ANSI S1.11 (R2009) Class 2  
ANSI S1.25 (R2007)  
ANSI S1.43 (R2007) Type 2

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.

Test points marked with a \* in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, I770.01 Rev J Supporting Firmware Version 2.301, 2015-04-30

LARSON DAVIS - A PCB PIEZOTRONICS DIV.

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Provo, UT 84601, United States  
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2022-3-11T11:57:51

**LARSON DAVIS**  
A PCB DIVISION

D0001.8406 Rev F

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# Calibration Certificate

Certificate Number 2022002377

Customer:

United Analyst and Engineering Consultant Co Ltd  
No. 81 Soi Udonut 41, Sukhumvit Road, Bangkok, Phra  
Khanong, Bangkok, 10260, Thailand

**Model Number** LxT2  
**Serial Number** 0006869  
**Test Results** Pass  
**Initial Condition** As Manufactured  
**Description** SoundTrack LxT Class 2  
Class 2 Sound Level Meter  
Firmware Revision: 2.404  
**Evaluation Method** Tested electrically using Larson Davis PRLMT2C SN 071570 and a 12.0 pF capacitor to simulate  
microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0  
mV/Pa.  
**Compliance Standards** Compliant to Manufacturer Specifications and the following standards when combined with  
Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 2  
ANSI S1.4 (R2006) Type 2  
IEC 60804:2000 Type 2  
IEC 61252:2002  
ANSI S1.25 (R2007)  
IEC 61672:2013 Class 2  
ANSI S1.43 (R2007) Type 2  
IEC 61260:2001 Class 2  
ANSI S1.11 (R2008) Class 2

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure  
(unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI)  
through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the  
requirements of ISO/IEC 17025:2017. Test points marked with a \* in the uncertainties column do not fall within this laboratory's  
scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to  
complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by  
the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A  
coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at  
approximately 95% confidence level.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing  
from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Ltd, I770.01 Rev O Supporting Firmware Version  
4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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Certificate Number 2022003082

## Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test  
(UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part  
1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.24	-0.20	-1.70	1.30	0.23	Pass
1000	0.14	0.00	-1.00	1.00	0.23	Pass
8000	-2.43	-3.00	-8.00	2.00	0.32	Pass

— End of measurement results—

### Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	41.00

— End of measurement results—

— End of Report—

Signatory: *Jacob Cannon*

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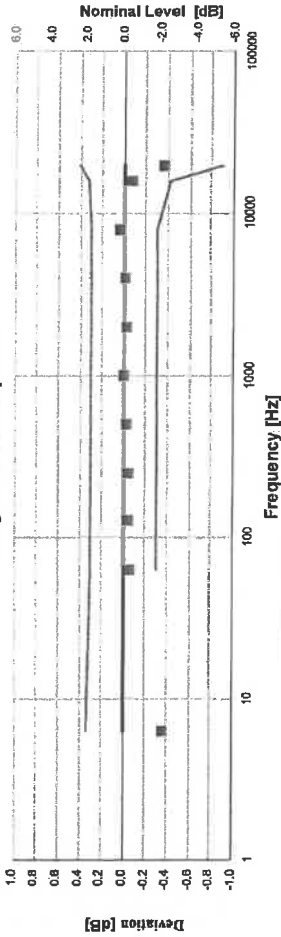
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D0001.8406 Rev F

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Z-weight Filter Response



Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3, 13 for compliance to IEC 61672-1:2013 5.5, IEC 60651-2001 6.1 and 9.2.2, IEC 60804:2000 5, ANSI S1.4-1993 (R2006) 5.1 and 8.2.1, ANSI S1.4-2014 Part 1: 5.5

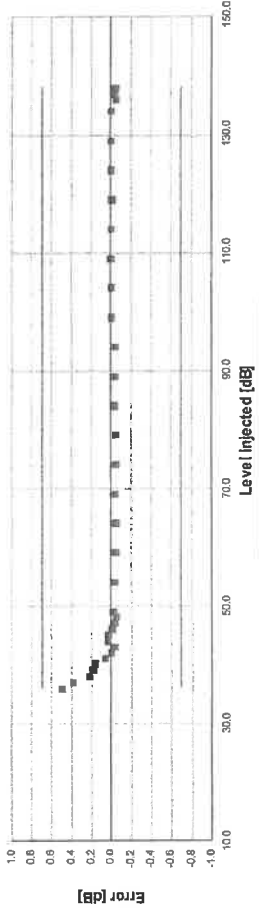
Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
63.10	-0.37	-0.37	-1.11	0.33	0.15	Pass
125.89	-0.06	-0.06	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
1,000.00	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,995.26	0.00	0.00	-0.30	0.30	0.15	Pass
3,981.07	-0.03	-0.03	-0.30	0.30	0.15	Pass
7,943.28	-0.01	-0.01	-0.30	0.30	0.15	Pass
15,848.93	0.04	0.04	-0.30	0.30	0.15	Pass
19,952.62	-0.08	-0.08	-0.42	0.32	0.15	Pass
	-0.36	-0.36	-0.91	0.41	0.15	Pass

— End of measurement results—

Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Hut Scientific 2626-H Temperature Probe	2021-02-04	2022-08-04	006767
SRS DS360 Ultra Low Distortion Generator	2021-04-13	2022-04-13	007635



A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2008) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.50	-0.70	0.70	0.16	Pass
37.00	0.38	-0.70	0.70	0.16	Pass
38.00	0.22	-0.70	0.70	0.16	Pass
39.00	0.19	-0.70	0.70	0.16	Pass
40.00	0.17	-0.70	0.70	0.16	Pass
41.00	0.05	-0.70	0.70	0.16	Pass
42.00	0.00	-0.70	0.70	0.16	Pass
43.00	-0.04	-0.70	0.70	0.16	Pass
44.00	0.04	-0.70	0.70	0.17	Pass
45.00	0.03	-0.70	0.70	0.16	Pass
46.00	-0.01	-0.70	0.70	0.16	Pass
47.00	-0.03	-0.70	0.70	0.16	Pass
48.00	-0.05	-0.70	0.70	0.16	Pass
49.00	-0.02	-0.70	0.70	0.16	Pass
54.00	-0.03	-0.70	0.70	0.16	Pass
59.00	-0.05	-0.70	0.70	0.16	Pass
64.00	-0.05	-0.70	0.70	0.16	Pass
69.00	-0.04	-0.70	0.70	0.16	Pass
74.00	-0.05	-0.70	0.70	0.16	Pass
79.00	-0.05	-0.70	0.70	0.16	Pass
84.00	-0.04	-0.70	0.70	0.16	Pass
89.00	-0.04	-0.70	0.70	0.16	Pass
94.00	-0.04	-0.70	0.70	0.16	Pass
99.00	0.00	-0.70	0.70	0.15	Pass
104.00	0.00	-0.70	0.70	0.15	Pass
109.00	0.00	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	-0.01	-0.70	0.70	0.15	Pass
124.00	0.00	-0.70	0.70	0.15	Pass
129.00	0.00	-0.70	0.70	0.15	Pass
134.00	0.00	-0.70	0.70	0.15	Pass
136.00	-0.05	-0.70	0.70	0.15	Pass
137.00	-0.04	-0.70	0.70	0.15	Pass
138.00	-0.04	-0.70	0.70	0.15	Pass

-- End of measurement results--

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Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper Limit [dB]	Result
A-weight Noise Floor	27.11	36.00	Pass
C-weight Noise Floor	27.00	35.00	Pass
Z-weight Noise Floor	32.93	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.72	134.15	135.75	0.15	Pass
THD	-67.19	-58.00	-58.00	0.00	Pass
THD+N	-63.08	-58.00	-58.00	0.00	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
136.95	40	Negative Pulse	135.14	133.71	135.71	0.15
		Positive Pulse	135.14	133.70	135.70	0.15
	30	Negative Pulse	134.20	133.71	135.71	0.15
		Positive Pulse	134.17	133.70	135.70	0.15

-- End of measurement results--

Positive Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limit [dB]	Expanded Uncertainty [dB]	Result
135.95	3	OVL	± 1.00	0.15	Pass
	5	OVL	± 1.00	0.15	Pass
125.95	3	-0.18	± 1.00	0.15	Pass
	5	-0.18	± 1.00	0.16	Pass
115.95	3	-0.22	± 1.00	0.15	Pass
	5	-0.16	± 1.00	0.15	Pass
105.95	3	-0.19	± 1.00	0.15	Pass
	5	-0.16	± 1.00	0.15	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limit [dB]	Expanded Uncertainty [dB]	Result
135.95	3	OVL	± 1.00	0.15	Pass
	5	OVL	± 1.00	0.15	Pass
125.95	3	-0.17	± 1.00	0.15	Pass
	5	-0.16	± 1.00	0.15	Pass
115.95	3	-0.19	± 1.00	0.15	Pass
	5	-0.16	± 1.00	0.15	Pass
105.95	3	-0.19	± 1.00	0.15	Pass
	5	-0.16	± 1.00	0.15	Pass

-- End of measurement results--

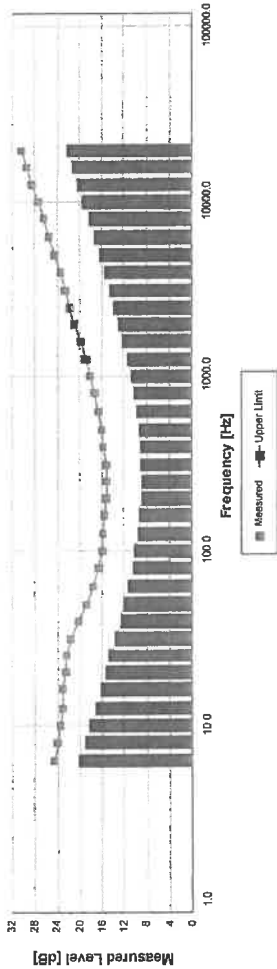
Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.85	93.78	93.98	0.15	Pass
0 dB Gain, Linearity	40.31	39.28	40.88	0.16	Pass
OBA Low Range	93.90	93.78	93.98	0.15	Pass
OBA Normal Range	93.88	93.20	94.80	0.15	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper Limit [dB]	Result
6.30	20.13	24.60	Pass
8.00	19.06	24.00	Pass
10.00	18.35	23.50	Pass
12.50	17.22	23.00	Pass
16.00	16.30	22.90	Pass
20.00	15.31	22.40	Pass
25.00	14.86	22.30	Pass
31.50	13.72	21.50	Pass
40.00	12.58	20.20	Pass
50.00	12.09	18.80	Pass
63.00	11.28	17.60	Pass
80.00	10.56	16.60	Pass
100.00	10.19	15.90	Pass
125.00	9.44	15.70	Pass
160.00	9.26	15.50	Pass
200.00	8.90	15.20	Pass
250.00	8.76	15.20	Pass
315.00	8.96	15.20	Pass
400.00	9.07	15.70	Pass
500.00	9.39	16.00	Pass
630.00	9.74	16.60	Pass
800.00	10.23	17.30	Pass
1,000.00	10.78	18.10	Pass
1,250.00	11.46	18.90	Pass
1,600.00	12.20	19.80	Pass
2,000.00	12.96	20.80	Pass
2,500.00	13.83	21.70	Pass
3,150.00	14.67	22.60	Pass
4,000.00	15.58	23.50	Pass
5,000.00	16.50	24.50	Pass
6,300.00	17.43	25.50	Pass
8,000.00	18.44	26.50	Pass
10,000.00	19.39	27.40	Pass
12,500.00	20.41	28.50	Pass
16,000.00	21.41	29.50	Pass
20,000.00	22.37	30.40	Pass

-- End of measurement results--

Signatory: *Joseph Cannon*



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For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to 1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014Part3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 2 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014Part 1.

Description	Cal Date	Cal Date	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2021-09-10	2022-09-10	001250
Hart Scientific 2626-H Temperature Probe	2021-02-04	2022-02-04	006767
Larson Davis CAL200 Acoustic Calibrator	2021-07-21	2022-07-21	007027
Larson Davis Model 831	2022-02-21	2023-02-21	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2022-03-02	2023-03-02	007185
SRS DS360 Ultra Low Distortion Generator	2021-04-13	2022-04-13	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2021-09-28	2022-09-28	PCB00004783

### Acoustic Calibration

Measured according to IEC 61672-3:2013, 10, and ANSI S1.4-2014, Part 3: 10

Measurement	Test Result (dB)	Lower Limit (dB)	Upper Limit (dB)	Expanded Uncertainty (dB)	Result
1000 Hz	114.01	113.90	114.20	0.14	Pass

### Loaded Circuit Sensitivity

Measurement	Test Result (dB)	Lower Limit (dB)	Upper Limit (dB)	Expanded Uncertainty (dB)	Result
1000 Hz	-60.54	-62.44	-48.33	0.14	Pass
— End of measurement results—					

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D0001.8406 Rev F

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# Calibration Certificate

Certificate Number 2022003087

Customer:

United Analyst and Engineering Consultant Co Ltd  
No. 81 Soi Udonank 41, Sukhumvit Road,  
Bangchak, Phra Khanong,  
Bangkok, 10260, Thailand

Model Number LxT2

Serial Number 0006691

Test Results Pass

Initial Condition As Manufactured

Description SoundTrack LxT Class 2

Class 2 Sound Level Meter

Firmware Revision: 2.404

Procedure Number

Technician Jacob Cannon

Calibration Date 11 Mar 2022

Calibration Due

Temperature 23.67 °C ± 0.25 °C

Humidity 52.4 %RH ± 2.0 %RH

Static Pressure 87.17 kPa ± 0.13 kPa

Evaluation Method

Tested with:

PCB 375A04, SIN 335075

Larson Davis CAL291, SIN 0108

Larson Davis CAL200, SIN 9079

Larson Davis PRMLxT2C, SIN 071560

Compliance Standards

Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

ANSI S1.4-2014 Class 2  
IEC 60851:2001 Type 2  
IEC 60804:2000 Type 2  
IEC 61252:2002  
IEC 61260:2001 Class 2  
IEC 61672:2013 Class 2  
ANSI S1.4 (R2006) Type 2  
ANSI S1.11 (R2006) Class 2  
ANSI S1.25 (R2007)  
ANSI S1.43 (R2007) Type 2

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.  
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, 1770.01 Rev J Supporting Firmware Version 2.301, 2016-04-30

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# Calibration Certificate

Certificate Number 2022002970

Customer:  
United Analyst and Engineering Consultant Co Ltd  
No. 81 Soi Udonnuk 41, Sukhumvit Road, Bangkok, Phra  
Khanong, Bangkok, 10260, Thailand

Model Number LxT2  
Serial Number 0006991  
Test Results Pass  
Initial Condition As Manufactured  
Description SoundTrack LxT Class 2  
Class 2 Sound Level Meter  
Firmware Revision: 2.404

Procedure Number D0001.8378  
Technician Jacob Cannon  
Calibration Due 9 Mar 2022  
Calibration Date 24 °C ± 0.25 °C  
Humidity 51.7 %RH ± 2.0 %RH  
Static Pressure 85.34 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLX12C S/N 071560 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:  
IEC 60651:2001 Type 2  
ANSI S1.4-2014 Class 2  
ANSI S1.4 (R2006) Type 2  
ANSI S1.25 (R2007)  
IEC 61252:2002  
ANSI S1.43 (R2007) Type 2  
IEC 61672:2013 Class 2  
ANSI S1.11 (R2009) Class 2

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.  
This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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Certificate Number 2022003087

## Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3. 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.24	-0.20	-1.70	1.30	0.23	Pass
1000	0.17	0.00	-1.00	1.00	0.23	Pass
8000	-2.35	-3.00	-8.00	2.00	0.32	Pass

— End of measurement results—

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	40.82

— End of measurement results—

Signatory: Jacob Cannon

— End of Report—

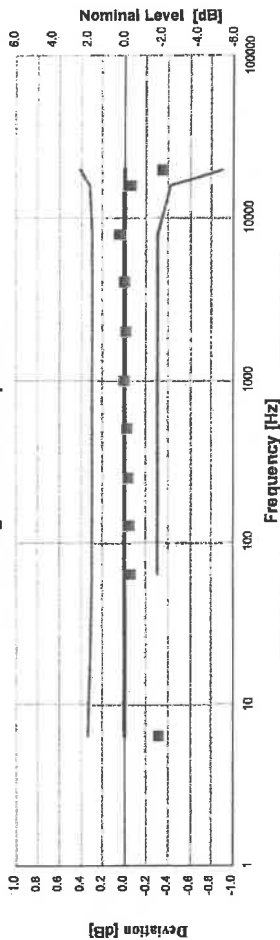
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Z-weight Filter Response



Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3.13 for compliance to IEC 61672-1:2013 5.5, IEC 60651:2001 6.1 and 9.2.2, IEC 60804:2000 5, ANSI S1.4:1983 (R2005) 5.1 and 8.2.1, ANSI S1.4-2014 Part 1: 5.5

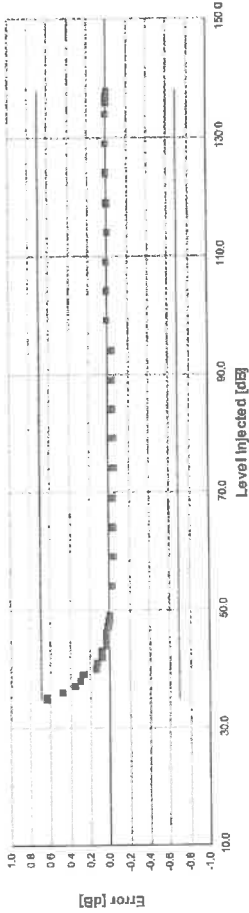
Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.31	-0.31	-1.11	0.33	0.15	Pass
63.10	-0.07	-0.07	-0.30	0.30	0.15	Pass
125.89	-0.05	-0.05	-0.30	0.30	0.15	Pass
251.19	-0.04	-0.04	-0.30	0.30	0.15	Pass
501.19	-0.02	-0.02	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.02	-0.02	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.04	0.04	-0.30	0.30	0.15	Pass
15,848.93	-0.06	-0.06	-0.42	0.32	0.15	Pass
19,952.62	-0.35	-0.35	-0.91	0.41	0.15	Pass

— End of measurement results—

**Description**  
Hart Scientific 2626-H Temperature Probe  
SRS DS360 Ultra Low Distortion Generator

**Standards Used**  
Cal Date 2021-02-04  
Cal Due 2022-08-04  
Cal Standard 006767  
007118





Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804-2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 8.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
35.00	0.64	-0.70	0.70	0.16	Pass
36.00	0.49	-0.70	0.70	0.16	Pass
37.00	0.35	-0.70	0.70	0.16	Pass
38.00	0.30	-0.70	0.70	0.16	Pass
39.00	0.27	-0.70	0.70	0.16	Pass
40.00	0.14	-0.70	0.70	0.16	Pass
41.00	0.13	-0.70	0.70	0.16	Pass
42.00	0.09	-0.70	0.70	0.16	Pass
43.00	0.09	-0.70	0.70	0.17	Pass
44.00	0.03	-0.70	0.70	0.17	Pass
45.00	0.04	-0.70	0.70	0.16	Pass
46.00	0.04	-0.70	0.70	0.16	Pass
47.00	0.02	-0.70	0.70	0.16	Pass
48.00	0.01	-0.70	0.70	0.16	Pass
49.00	0.00	-0.70	0.70	0.16	Pass
54.00	-0.03	-0.70	0.70	0.16	Pass
59.00	-0.04	-0.70	0.70	0.16	Pass
64.00	-0.03	-0.70	0.70	0.16	Pass
69.00	-0.04	-0.70	0.70	0.16	Pass
74.00	-0.05	-0.70	0.70	0.16	Pass
79.00	-0.05	-0.70	0.70	0.16	Pass
84.00	-0.04	-0.70	0.70	0.16	Pass
89.00	-0.04	-0.70	0.70	0.16	Pass
94.00	-0.04	-0.70	0.70	0.15	Pass
99.00	0.01	-0.70	0.70	0.15	Pass
104.00	0.02	-0.70	0.70	0.15	Pass
109.00	0.01	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	0.01	-0.70	0.70	0.15	Pass
124.00	0.01	-0.70	0.70	0.15	Pass
129.00	0.01	-0.70	0.70	0.15	Pass
134.00	0.01	-0.70	0.70	0.15	Pass
136.00	0.01	-0.70	0.70	0.15	Pass
137.00	0.01	-0.70	0.70	0.15	Pass
138.00	0.00	-0.70	0.70	0.15	Pass

-- End of measurement results--

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Amplitude [dB]	Duration [μs]	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
136.95	40	Negative Pulse	135.14	133.65	135.65	0.15
		Positive Pulse	135.12	133.64	135.64	0.15
	30	Negative Pulse	134.20	133.65	135.65	0.15
		Positive Pulse	134.20	133.64	135.64	0.15

-- End of measurement results--

### Positive Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
135.95	3	OVL	± 1.00	0.15 ±	Pass
	5	OVL	± 1.00	0.15 ±	Pass
125.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.15	± 1.00	0.16 ±	Pass
115.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
105.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass

-- End of measurement results--

### Negative Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
135.95	3	OVL	± 1.00	0.15 ±	Pass
	5	OVL	± 1.00	0.15 ±	Pass
125.95	3	-0.12	± 1.00	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
115.95	3	-0.13	± 1.00	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
105.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass

-- End of measurement results--

### Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.96	93.91	94.11	0.15	Pass
0 dB Gain, Linearity	40.28	39.41	40.81	0.16	Pass
OBA Low Range	94.02	93.91	94.11	0.15	Pass
OBA Normal Range	94.01	93.20	94.80	0.15	Pass

-- End of measurement results--

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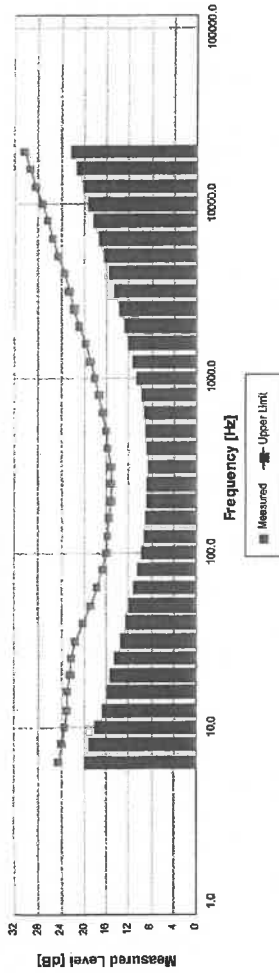


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1/3-Octave Self-Generated Noise



The SUM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper Limit [dB]	Result
6.30	19.93	24.60	Pass
8.00	19.05	24.00	Pass
10.00	18.09	23.50	Pass
12.50	16.82	23.00	Pass
16.00	15.82	22.90	Pass
20.00	15.31	22.40	Pass
25.00	14.66	22.30	Pass
31.50	13.58	21.50	Pass
40.00	12.50	20.20	Pass
50.00	11.82	18.80	Pass
63.00	11.10	17.60	Pass
80.00	10.41	16.60	Pass
100.00	9.77	15.90	Pass
125.00	9.30	15.70	Pass
160.00	9.00	15.50	Pass
200.00	8.78	15.20	Pass
250.00	8.72	15.20	Pass
315.00	8.68	15.20	Pass
400.00	8.73	15.70	Pass
500.00	8.96	16.00	Pass
630.00	9.37	16.60	Pass
800.00	9.86	17.30	Pass
1,000.00	10.60	18.10	Pass
1,250.00	11.29	18.90	Pass
1,600.00	12.01	19.80	Pass
2,000.00	12.77	20.80	Pass
2,500.00	13.64	21.70	Pass
3,150.00	14.52	22.60	Pass
4,000.00	15.43	23.50	Pass
5,000.00	16.38	24.50	Pass
6,300.00	17.34	25.50	Pass
8,000.00	18.30	26.50	Pass
10,000.00	19.27	27.40	Pass
12,500.00	20.25	28.50	Pass
16,000.00	21.24	29.50	Pass
20,000.00	22.23	30.40	Pass

-- End of measurement results--



Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3 11.2

Measurement	Test Result [dB]	Upper Limit [dB]	Result
A-weight Noise Floor	26.93	36.00	Pass
C-weight Noise Floor	26.82	35.00	Pass
Z-weight Noise Floor	32.70	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Result
10 Hz Signal	135.87	134.15	135.75	Pass
THD	-55.74		-58.00	0.01 ± Pass
THD+N	-62.05		-68.00	0.01 ± Pass

-- End of measurement results--



Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tambon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-es.com

Certificate No. : E22-08034

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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 : 17/08/2022  
 Issue Date : 17/08/2022

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 (SI).

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 Manager



-- End of Report--

Signatory: *Jessie Cannon*

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Certificate No. : E22-08034  
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Meter Console Information			Calibration Conditions			Factors/Conversions	
Console Model Number	XC-572-V		Date	Time	17/08/2022	10:20 AM	Std Temp 293 K
Console Serial Number	1701018		Calibration Reference No.		E22-08034		Std Press 760 mm Hg
DGM Model Number	SK25EX		Barometric Pressure		755.99		K <sub>i</sub> 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		Variation	
(V <sub>meas</sub> ) m <sup>3</sup>	(Q <sub>meas</sub> ) m <sup>3</sup> /min	(V <sub>ref</sub> ) m <sup>3</sup>	(Q <sub>ref</sub> ) m <sup>3</sup> /min	Value (Y)	Variation (ΔY)	Std & Corr (Q <sub>std/corr</sub> ) m <sup>3</sup> /min	.0212 m <sup>3</sup> /min (ΔH <sub>g</sub> ) mm H <sub>2</sub> O	ΔH <sub>g</sub> (ΔH <sub>g</sub> )	Variation (ΔH <sub>g</sub> )
0.136	0.011	0.139	0.011	1.022	0.009	0.011	46.016	-1.144	
0.136	0.011	0.139	0.011	1.020	0.007	0.011	46.632	-0.528	
0.137	0.016	0.140	0.016	1.022	0.009	0.016	45.525	-1.635	
0.137	0.016	0.139	0.016	1.019	0.006	0.016	45.728	-1.431	
0.274	0.019	0.279	0.019	1.019	0.006	0.019	48.607	1.447	
0.274	0.019	0.278	0.019	1.014	0.002	0.019	48.884	1.725	
0.276	0.025	0.278	0.026	1.009	-0.003	0.026	47.409	0.249	
0.276	0.025	0.278	0.026	1.007	-0.006	0.026	47.609	0.449	
0.276	0.029	0.276	0.029	0.999	-0.014	0.029	47.509	0.349	
0.276	0.029	0.276	0.029	0.997	-0.016	0.029	47.678	0.518	
				1.013	Y Average			47.160	ΔH <sub>g</sub> 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<sub>g</sub>, orifice pressure differential that equates to 0.75 cfm (0.0212 m<sup>3</sup>/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H<sub>2</sub>O



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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	17/08/2022	10:20 AM	Std Temp	293	K		
Console Serial Number	1701018			Calibration Reference No.		E22-08034		Std Press	760	mm Hg		
DGM Model Number	SK25EX			Barometric Pressure		755.99		K <sub>i</sub>	0.386			
DGM Serial Number	00002030			Calibration Meter Gamma		0.999		Console Leak Check				PASS

Calibration Data											
Run Time		Metering Console				Calibration Meter					
		DGM Orifice	Volume	Volume	Outlet Temp	Volume	Volume	Outlet Temp	Volume	Outlet Temp	
Elapsed		DH	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
(Q)	(P <sub>m</sub> )		(V <sub>m</sub> )	(V <sub>m</sub> )	(t <sub>m</sub> )	(t <sub>m</sub> )	(V <sub>w</sub> )	(V <sub>w</sub> )	(t <sub>w</sub> )	(t <sub>w</sub> )	
min	mm H <sub>2</sub> O		m <sup>3</sup>	m <sup>3</sup>	°C	°C	m <sup>3</sup>	m <sup>3</sup>	°C	°C	
12.50	13.0		1910.8900	1911.0300	27	27	85.69988	85.84334	27	27	
12.55	13.0		1911.0300	1911.1700	27	27	85.84334	85.98642	27	27	
8.80	26.0		1911.1810	1911.3210	27	27	85.99774	86.14128	26	26	
8.80	26.0		1911.3210	1911.4610	28	28	86.14128	86.28450	26	26	
14.62	40.0		1911.4740	1911.7540	28	28	86.29780	86.58438	26	26	
14.60	40.0		1911.7540	1912.0340	28	28	86.58438	86.86982	26	26	
10.83	70.0		1912.0450	1912.3250	28	28	86.88092	87.16578	25	25	
10.83	70.0		1912.3250	1912.6050	29	29	87.16578	87.45004	25	25	
9.47	90.0		1912.6190	1912.8990	29	29	87.46412	87.74662	25	25	
9.47	90.0		1912.8990	1913.1790	29	29	87.74662	88.02862	25	25	



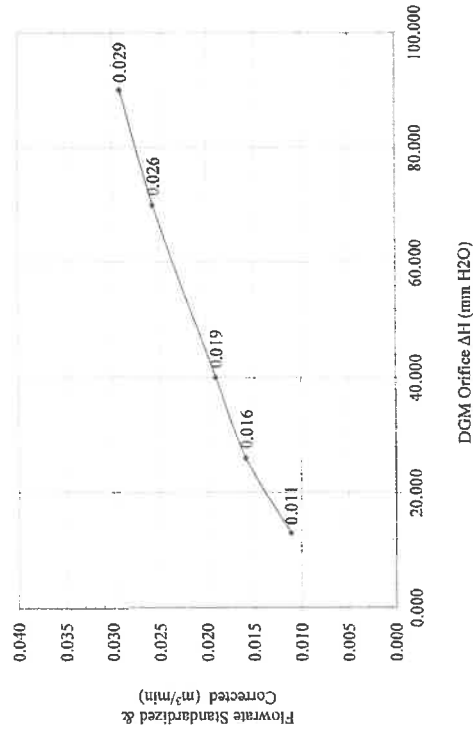
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Certificate No. : E22-08034  
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Meter Console Information		Calibration Conditions		Factors/Conversions	
Console Model Number	XC-572-V	Date	17/08/2022	Std Temp	293 K
Console Serial Number	1701018	Calibration Reference No.	E22-08034	Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	755.99	K1	0.386
DGM Serial Number	00002030	Calibration Meter Gamma	0.999	Console Leak Check	PASS

Calibration Date: 17-8-2022 Calibration Reference No: E22-08034

### Meter Pressure vs Flowrate



Console Serial: 1701018 Console Model: XC-572-V



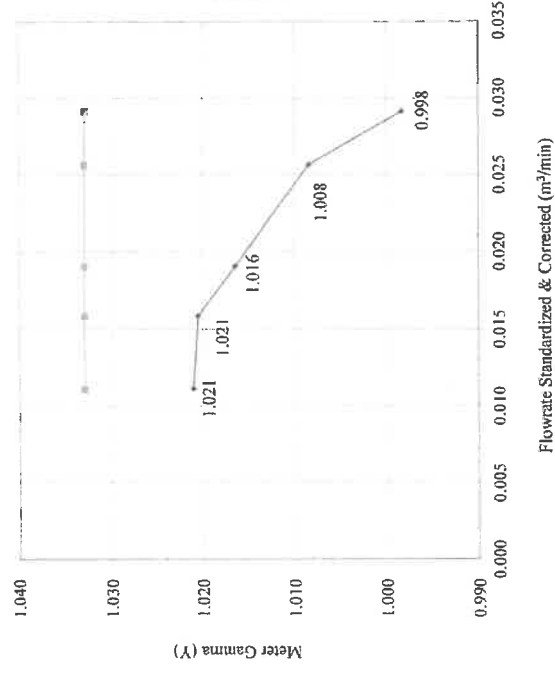
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Meter Console Information		Calibration Conditions		Factors/Conversions	
Console Model Number	XC-572-V	Date	17/08/2022	Std Temp	293 K
Console Serial Number	1701018	Calibration Reference No.	E22-08034	Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	755.99	K1	0.386
DGM Serial Number	00002030	Calibration Meter Gamma	0.999	Console Leak Check	PASS

Calibration Date: 17-8-2022 Calibration Reference No: E22-08034

### Meter Gamma vs Flowrate



Console Serial: 1701018 Console Model: XC-572-V



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Instrument description : Flue gas Analyzer  
Instrument model : Testo 350 New  
Instrument serial no. : 60899615  
ID no. or control no. : UAEFFM. 006/2560  
Manufacturer : Testo SE & Co. KGaA  
Probe description : -  
Probe model : -  
Probe serial : -  
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 : 3 Pages  
Receiving no. : L-224380  
Receiving date. : 14-Dec-22  
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.8,601.1 ppm)  
Condition of UUC. : Used  
Ambient condition : All of the Measurement were carried out the stabilized laboratory  
Temperature : 23 ±5 °C  
Humidity : 55 ± 15 %RH  
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
Calibration procedure no. : WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.  
This certificate is applied only to item under test Environmental condition.  
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.  
Calibration certificates without signature and seal not valid.  
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 20-Dec-22

FW-CL-09-C Rev.8

# THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 16103

Calibration Conditions	
Date	17/08/2022 12:40 PM
Calibration Reference No.	E22-08034
Reference Thermometer	DIGICON
Serial Number	183169105

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	23.0	36.0	92.0	148.0	257.0	370.0	480.0	591.0	813.0	1035.0
Aux	-17.0	23.0	36.0	92.0	148.0						
Probe	-17.0	23.0	36.0	92.0	148.0						
Filter	-16.0	23.0	36.0	92.0	148.0						
Oven	-17.0	23.0	36.0	92.0	148.0						
Exit	-16.0	23.0	36.0								

## Tolerance Range

Stack ± 1.50% Absolute  
Probe ± 3.0 °C  
Filter ± 3.0 °C

Meter ± 3.0 °C  
Exit ± 2.0 °C





Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.498	2.61	0.112	0.20
O <sub>2</sub> (%Vol)	10.04	10.14	0.10	0.40
O <sub>2</sub> (%Vol)	21.02	21.15	0.13	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	310	0.1	6.0
CO (ppm)	1003	1001	-2	12
NO <sub>2</sub> (ppm)	30.34	31.3	0.96	8.0
NO <sub>2</sub> (ppm)	80.96	82.1	1.14	8.0
NO <sub>2</sub> (ppm)	202.2	205.6	3.4	12
NO (ppm)	30.08	32	1.92	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.6	322	1.4	12
SO <sub>2</sub> (ppm)	50.04	51	0.96	6.0
SO <sub>2</sub> (ppm)	100.8	102	1.2	6.0
SO <sub>2</sub> (ppm)	601.1	605	3.9	13

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

## End of Report



Cert.No.: 22CH1441  
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#### Condition of this calibration result

1. Reference Standard Instrument :-
- | Instrument                     | Serial No. | ID No.   | Cert. No. | Due Date    |
|--------------------------------|------------|----------|-----------|-------------|
| 1) Document Process Calibrator | 54030049   | 130RC116 | 22E2769   | 24 Aug 2023 |
| 2) Ref. Standard Thermometer   | 4982054    | 110RC044 | 2111201   | 26 Oct 2022 |
- This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

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	788995	01 Jan 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	823323	20 June 2023

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 Fluke at pH (4,7)(7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( $\pm$ mV)	Coverage factor k
			mV	pH		
pH Meter S/N.: HA1G0008	4.00	177.48	177.5	4.01	0.058	2.00
	7.00	0.00	0.0	7.02	0.058	2.00
	10.00	-177.48	-177.5	10.01	0.058	2.00



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Cert.No.: 22CH1441  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Horiba  
Model : LAQUA-PH210  
Serial No. : HA1G0008  
ID No. : UAE.EFM.201/2564(EFM.pH.09/64)  
Condition As-Received: Used Item  
Received Date : 20 October 2022  
Calibration Date : 21 October 2022  
Reference : 2210-0894WSC-2  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Ambient Temperature : (25  $\pm$  2.5) °C  
Relative Humidity : (50  $\pm$  15) %  
Calibration Procedure : In - house method :  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Walalak Sirirthean

Approved by :   
Approved Signatory

(☒) Malee Bulkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagtrakul

Issue Date : 26 October 2022

The Uncertainties are for a confidence probability of approximately 95 %

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Cert.No.: 22TW232  
Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : Horiba  
Model : LAQUA-DO210  
Serial No. : HE1D0008  
ID No. : UAE.EFM.207/2564(EFM.DO.09/64)  
Received Date : 20 October 2022  
Test Date : 20 October 2022  
Reference : 2210-0694WSC-9  
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 : Warakorn Lerngagtrakul

Approved by :

( / ) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lerngagtrakul

Issue Date :

2 November 2022

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Cert.No.: 22CH1441  
Page.: 3 of 3

### Calibration Results

Function : pH Measurement

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

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.: 991F0169	4.008	4.01	144.6	0.0085	2.05
	6.987	6.99	-28.3	0.011	2.00
	6.987	7.00	-28.7	0.011	2.00
	10.008	10.01	-203.3	0.0085	2.00

Function : Temperature Measurement

( \* ) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652  
- Serial No. : 991F0169  
Dimension of probe:  
- Length : 103 mm.  
- Diameter : 16 mm.  
- Immersion Depth : 90 mm.

Calibration Point ( °C )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of measurement ( ± °C )	Coverage factor k
25.0	25.000	24.9	-0.100	0.13	2.00
30.0	30.001	29.9	-0.101	0.13	2.00
35.0	34.999	34.9	-0.099	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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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Cert. No.: 22LM150  
Page.: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : Horiba

Model : LAQUA-DO210

Serial No. : HE1D0008

ID No. : UAE.EFM.207/2564(EFM.DO.09/64)

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

Location : TPA On Site Calibration Laboratory

Received Order : 20 October 2022

Calibrated Date : 31 October 2022

Ambient Temperature : ( 26 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

AC Line Voltage : ( 220 ± 22 ) V

Calibrated by : Preecha Hlahib

Approved by :

( ) Ponthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 1 November 2022

The Uncertainties are for a confidence probability of approximately 95 %

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Cert.No.: 22TW232  
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	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

#### 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.: 9K1B0020

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.13	0.027

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned 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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Cert.No.: 22CH1436  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Conductivity Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-EC210  
**Serial No. :** HC0K0005  
**ID No. :** UAE.EFM.204/2564(EFM.SCT.09/64)  
**Condition As-Received:** Used Item  
**Received Date :** 20 October 2022  
**Calibration Date :** 20 October 2022  
**Reference :** 2210-0694WSC-5  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
**Ambient Temperature :**  $(25 \pm 2.5) ^\circ\text{C}$   
**Relative Humidity :**  $(50 \pm 15) \%$   
**Calibration Procedure:**  
In -house method :  
- CP-CH6 by direct measurement  
with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

**Calibrated by :** Warakorn Lemgagrakul

**Approved by :**

(✓) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

**Issue Date :** 26 October 2022

**The Uncertainties are for a confidence probability of approximately 95 %**

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

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**Equipment :** DO Meter with Sensor  
**Condition As-Received :** Used Item  
**Reference :** 2210-0694WSC-10

Cert. No.: 22LM150  
Page.: 2 of 2

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPT ) into Temperature Bath.  
The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-
- | Instrument             | Model | Serial No. | Cert. No. | Due Date    |
|------------------------|-------|------------|-----------|-------------|
| 1) Digital Thermometer | 1523  | 3240076    | 22I249    | 02 Mar 2023 |
2. This 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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K1B0020

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
25.0	100	25.000	24.8	-0.200	0.16	2.00
30.0	100	30.005	29.8	-0.205	0.16	2.00
35.0	100	35.001	34.8	-0.201	0.16	2.00

**UUC\* :** Unit Under Calibration

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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a 1133168



Cert.No.: 22CH1436  
Page.: 3 of 3

#### Calibration Results

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9383  
- Serial No. : 9B0M0068  
- Length : 113 mm.  
- Diameter : 10 mm.  
- Immersion Depth : 90 mm.

Dimension of probe;

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement ( $\pm$ °C)	Coverage factor k
25.0	25.001	25.0	-0.001	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.003	35.0	-0.003	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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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Cert.No.: 22CH1436  
Page.: 2 of 3

#### Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument

1) Thermometer

2) Ref. Std. Thermometer

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

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI

through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution

1413.0  $\mu$ S/cm

12.880 mS/cm

Manufacturer

CPA Chem

CPA Chem

Lot No.

823328

823329

Exp. date

20 June 2023

20 June 2023

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

Control Conductivity calibration solution temperature by Water bath (25 $\pm$ 0.1) °C

Calibration results

Function : Conductivity Measurement

(\*) After Adjustment at 1413.0  $\mu$ S/cm

Conductivity Electrode Serial No.: 9B0M0068

Standard

Conductivity Solution

1413.0  $\mu$ S/cm

12.880 mS/cm

Before Adjustment

UUC\* Reading

1323  $\mu$ S/cm

11.75 mS/cm

After Adjustment

UUC\* Reading

1412  $\mu$ S/cm

12.60 mS/cm

Uncertainty

of Measurement

( $\pm$ )

9.2  $\mu$ S/cm

0.086 mS/cm

Coverage

factor

k

2.00

2.00

Remark - UUC\* = Unit Under Calibration

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a 1132034

**Certificate of Calibration**

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

**Certificate No :** 22-LXM-104  
**Request No :** Req-2022-0648  
**Page :** 1/2

**Unit Under Calibration Details**

Instrument Name : Digital Lux Meter  
Manufacturer : EXTECH  
Model : 407026  
Serial Number : A056652  
Resolution : 1 lx  
ID Number : -

**Range Calibration :** 2000 , 20000 lx  
**Instrument Status :** New

**Calibration Environment and Details**

Temperature : 25 °C ± 2 °C  
Humidity : 60 %RH ± 20 %RH  
Received Date : 29 March 2022  
Calibrated Date : 04 April 2022  
Calibration Procedure : The measurement was done in accordance with CP-LXM-01

**Reference Standard**  
: Photometer and Illuminance Sensor, Serial No.: 30662/2, 30592/2, which was calibrated on 26 October 2021,  
Certificate No.: TP-1026-21

**Traceability**  
: This Certificate is traceable to International System of Unit (SI) Unit through National Institute of Metrology (Thailand)

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

**Approved By :**   
Mr. Patch Watanavorn  
Calibration Engineer Supervisor  
**Issue Date :** 04 April 2022

**Calibration Note**  
UUC Adjustment : Zero adjustment before use

**Result of Calibration :**

UUC Range (lx)	Standard (lx)	UUC Reading (lx)	Correction (lx)	Uncertainty (± lx)
2000	0	0	0	0.58
	50	50	0	
	100	101	-1	
	200	201	-1	
	300	302	-2	
	400	402	-2	
	600	604	-4	
	800	803	-3	
	1000	1005	-5	
	1200	1202	-2	
20000	1400	1397	3	2.3 % of Reading
	1600	1593	7	
	1800	1790	10	
	2000	1988	12	
	3000	2980	20	
	4000	3970	30	
	5000	4970	30	

**End of Certificate**

**Calibrated By :**   
Mr. Noppadon Luangart





## Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

451-451/1 Sirinthorn Rd.,Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23063  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00409030 / 189687 / 90495  
ID No.: UAE.EFM.012/2564

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 : 18 JANUARY 2023  
Calibration Date : 20 JANUARY 2023  
Date of Issue : 23 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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.

Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value ( dB )
13.8

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

Frequency Weighting	Measured value ( dB )
A - weight	9.9
C - weight	16.6
Flat	22.4

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	0.2	0.2	± 1.5
1000	0.0	0.0	± 1.0
8000	-0.6	-0.5	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
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

Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
Pages : 6 of 8

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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 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	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
Pages : 5 of 8

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
63	0.0	-0.1	0.0
125	0.0	0.0	0.0
250	0.0	0.0	0.0
500	0.0	0.0	0.0
1000	0.0	0.0	0.0
2000	0.0	0.0	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
Pages : 8 of 8

11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle	0.0	±1.5
89.6	89.6		

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

Continuation of Calibration Certificate

Cert. No. : ACL23063  
Job No. : VC66AC0027  
Pages : 7 of 8

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	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.3	-0.1	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

Cert. No. : ACL23028  
Job No. : VC66AC0023  
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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).

451-451/1 Srinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

Cert. No. : ACL23028  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00609500 / 189689 / 01126  
ID No.: -

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 : 06 JANUARY 2023  
Calibration Date : 10-12 JANUARY 2023  
Date of Issue : 16 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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.

Continuation of Calibration Certificate

Cert. No. : ACL23028  
Job No. : VC66AC0023  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value ( dB )
17.5

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

Frequency Weighting	Measured value ( dB )
A - weight	14.1
C - weight	20.6
Flat	26.3

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	0.0	0.0	± 1.5
1000	0.0	0.0	± 1.0
8000	0.2	0.3	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL23028  
Job No. : VC66AC0023  
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

Continuation of Calibration Certificate

Cert. No. : ACL23028  
Job No. : VC66AC0023  
Pages : 6 of 8

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	131.9	-0.1	± 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	74.0	0.0	± 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	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.2	0.2	± 1.1
28.0	28.2	0.2	± 1.1
27.0	27.3	0.3	± 1.1
26.0	26.3	0.3	± 1.1
25.0	25.4	0.4	± 1.1

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL23028  
Job No. : VC66AC0023  
Pages : 5 of 8

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
63	-0.1	-0.1	-0.1
125	0.0	0.0	-0.1
250	0.0	0.0	-0.1
500	0.0	0.0	-0.1
1000	0.0	0.0	0.0
2000	0.0	0.0	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

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Continuation of Calibration Certificate

Cert No. : ACL23028  
Job No. : VC66AC0023  
Pages : 8 of 8

11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle	-0.1	±1.5
89.6	89.5		

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

Continuation of Calibration Certificate

Cert No. : ACL23028  
Job No. : VC66AC0023  
Pages : 7 of 8

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, Lepeak ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0



Certificate No : 23-ACT-021  
Request No : Roq-2022-2269

Calibration Results : Without Adjustment

Sound pressure level

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	94.06	0.06	-	-	0.11	0.25
114 dB / 1000 Hz	114.07	0.07	-	-	0.11	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	-	-	0.10	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.10	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	0.04		-	-	0.40	2.5
114 dB / 1000 Hz	0.03		-	-	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

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT  
Name : CO.,LTD.

Certificate No : 23-ACT-021

Request No : Roq-2022-2269

Address : 81 Soi Udonsuk 41, Sukhumvit Road, Bangchak,  
Prakanong, Bangkok 10260

Unit Under Calibration Details

Measurement item : Acoustic Calibrator  
Manufacturer : SVANTEK  
Model : SV35  
Serial Number : 44792  
ID : UAE.FEM.0202559  
Class : I  
Range : 94 , 114 dB / 1000 Hz  
Instrument Status : Used

Calibration Environment and Details

Temperature : ( 23 ±2 °C )  
Humidity : (50 ± 20 %RH )  
Barometric Pressure : (1013 ±10.0 hPa )  
Received Date : 26 December 2022  
Calibration Date : 14 February 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 2023
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 :

14 February 2023

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : VC65AC0045  
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-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

451-451/1 Sirinthorn Rd, Banghumru, Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com

Cert. No. : ACL22083  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 01010777 / 194532 / 14655  
ID No.: -

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 : 11 APRIL 2022  
Calibration Date : 18-22 APRIL 2022  
Date of Issue : 25 APRIL 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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.

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : VC65AC0045  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	12.6
C - weight	19.3
Flat	24.9

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
125	0.0	0.1	0.1
1000	-0.1	-0.1	-0.1
8000	0.7	0.8	0.8

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : VC65AC0045  
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

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : YC65AC0045  
Pages : 6 of 8

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	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 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	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : YC65AC0045  
Pages : 5 of 8

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
63	-0.1	-0.1	-0.1
125	0.0	0.0	0.0
250	0.0	0.0	-0.1
500	0.0	0.0	-0.1
1000	0.0	0.0	0.0
2000	0.0	0.0	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : VC65AC0045  
Pages : 8 of 8

11. Overload indication

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

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

Continuation of Calibration Certificate

Cert. No. : ACL22083  
Job No. : VC65AC0045  
Pages : 7 of 8

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	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0



Certificate No : 23-NDM-010  
Request No : Req-2023-0054

1. Absolute acoustical sensitivity				
UUC Setting	Time		Exposure Measurement	
	Ref	UUC	Ref	UUC
FAST / A / 55-140	(s)	(s)	(Pa <sup>2</sup> h)	(Pa <sup>2</sup> h)
Calibrator Setting				
1000 Hz 114 dB	120.00	120	3.19	3.20
			+0.31	3.0
				-21, +26

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

2. Frequency weightings				
UUC Setting	Deviation from various		UNCERTAINTY	Tolerances
	Frequency	Weighting		
FAST / 55-140	A	C	( ± dB)	( ± dB)
STD Settling	(dB)	(dB)		
*G3 Hz	0.4	0.4	0.40	2.0
125 Hz	0.1	0.1	0.40	1.5
250 Hz	-0.1	-0.2	0.40	1.5
500 Hz	-0.1	-0.2	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	0.1	0.1	0.40	2.0
4000 Hz	0.9	0.7	0.40	3.0
8000 Hz	-1.8	-1.9	0.40	5.0

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Name :  
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260  
Certificate No : 23-NDM-010  
Request No : Req-2023-0054

Unit Under Calibration Details  
Measurement item : Noise dosimeter  
Manufacturer : SVANTEK  
Model : SV104  
Serial Number : 91924  
ID : -  
Resolution : 0.1 dB  
Calibration Environment and Details  
Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 10 January 2023  
Calibrated Date : 24 January 2023  
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017  
Location of Calibration : Lab Acoustic  
Microphone Class : 2  
Microphone Model : SV27  
Microphone S/N : 96600  
Preamplifier Model : -  
Preamplifier S/N : -  
Intumcut Status : Used

Instrument	Brand	Model	SN	Due calibration	Traceability
Multifrequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	Svanek	Svan401	131	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACT	24 March 2023	TPA

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 Luangant  
Calibration Officer  
Approved By :  
Mr. Pachi Malaiavorn  
Calibration Engineer Supervisor  
Issue Date : 24 January 2023

Certificate No : 23-NDM-010  
Request No : Req-2023-0054

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement		Tolerances Limit (Pa <sup>2</sup> h)
	Ref (s)	UUC (s)	Ref (Pa <sup>2</sup> h)	Error (Pa <sup>2</sup> h)	
FAST / A / 55-140	2846				
Calibrator Setting					
4000 Hz 95 dB	2846	2846	1.00	-0.02	0.01 -0.29 - 0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement		Tolerances Limit (%)
	Ref (s)	UUC (s)	Ref (Pa <sup>2</sup> h)	Error (%)	
FAST / A / 55-140					
Calibrator Setting					
Burst 1 ms, 95 dB	2846	2846	1.00	-2.00	-21 - +26
Burst 1 ms, 100 dB	900	900	1.00	-2.00	-21 - +41
Burst 1 ms, 108 dB	143	143	1.00	-1.00	-21 - +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement		Tolerances Limit (%)
	UUC (s)		UUC (Pa <sup>2</sup> h)	Different (%)	
FAST / A / 55-140					
Calibrator Setting					
Continuous Rectangle +	7		10.86		-21 - +26
Continuous Rectangle -			10.86	0.00	

\* Indicates non accredited

End of Certificate

Certificate No : 23-NDM-010  
Request No : Req-2023-0054

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	FAST / A / High											
	Ref	(dB)	55.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0	
1000 Hz	Level A	(dB)	54.7	80.2	90.2	100.1	110.1	114.0	120.0	130.0	140.0	
	Error	(dB)	-0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	
	Ref	(dB)			88.9	96.9	108.9	112.9	118.9	128.9	138.9	
8000 Hz	Level A	(dB)			88.9	99.0	108.9	112.9	118.9	128.9	138.8	
	Error	(dB)			0.0	0.1	0.0	0.0	0.0	0.0	-0.1	
	Ref	(dB)						87.8	93.8	103.8	113.8	
63 Hz	Level A	(dB)						87.8	93.8	103.8	113.8	
	Error	(dB)						0.0	0.0	0.0	0.0	
	Ref	(dB)										
Tolerances Limit		(±dB)	1.0									
UNCERTAINTY		(±dB)	0.27									

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement				Tolerances Limit (%)
	Ref (s)	UUC (s)	Ref (Pa <sup>2</sup> h)	UUC (Pa <sup>2</sup> h)	Error (%)	UNCERTAINTY (%)	
FAST / A / 55-140							
Calibrator Setting							
1000 Hz 110 dB	27	27	0.30	0.30	0.00		
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00	4.3	
1000 Hz 110 dB	180	180	2.00	1.98	-1.00		
1000 Hz 120 dB	36	36	4.00	3.94	-1.50		
1000 Hz 120 dB	72	72	8.00	7.87	-1.63		
1000 Hz 120 dB	90	90	10.00	9.90	-1.00		
1000 Hz 120 dB	180	180	20.00	19.76	-1.20	3.8	
1000 Hz 120 dB	360	360	40.00	39.42	-1.45		
1000 Hz 120 dB	720	720	80.00	78.66	-1.68		
							-21, +26



Certificate No : 22-ACT-533  
Request No : Req-2022-1570

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement		UNCERTAINTY (%)	Tolerances Limit (%)
	Ref (s)	UUC (s)	Ref (Pa h)	UUC (Pa h)		
FAST / A / 60-140 Calibrator Setting 1000 Hz 114 dB	120.00	120	3.40	3.43	3.0	-21, +26

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 36, SN. 107224

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY (± dB)	Tolerances Limit (± dB)
	A (dB)	C (dB)		
	0.2	0.2	0.40	2.0
FAST / 60-140 STD Setting *63 Hz	-0.4	-0.5	0.40	1.5
125 Hz	0.0	0.0	0.40	1.5
250 Hz	0.0	0.0	0.40	1.5
500 Hz	0.0	0.0	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.3	-0.3	0.40	2.0
4000 Hz	-0.1	-0.1	0.40	3.0
8000 Hz	-0.9	-1.0	0.40	5.0

Certificate of Calibration

Customer  
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Prakanng, Bangkok 10250

Certificate No : 22-ACT-533  
Request No : Req-2022-1570

Unit Under Calibration Details

Measurement item : Noise dosimeter  
Manufacturer : SVANTEK  
Model : SV 104IS  
Serial Number : 67628  
ID : -  
Resolution : 0.1 dB  
Calibration Environment and Details  
Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 11 August 2022  
Calibrated Date : 22 August 2022  
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61222 : 2017  
Location of Calibration : Lab Acoustic

Microphone Class : 2  
Microphone Model : SV 27IS  
Microphone SN : 68622  
Preamplifier Model : -  
Preamplifier SN : -  
Instrument Status : Used

Instrument	Brand	Model	SN	Due calibration	Traceability
Multifrequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSI
Standard Microphone	GRAS	40AN	188273	15 September 2022	GRAS
Sine Generator	Sonic	Syn401	131	18 October 2022	WK Electric
Timer	EXTECH	-	05-ACT	24 March 2023	TPA

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. Piut Mathayom  
Calibration Engineer Supervisor  
Issue Date : 22 August 2022

Certificate No : 22-ACT-533  
Request No : Reg-2022-15

#### 4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (Pa <sup>2</sup> h)	Tolerances Limit (Pa <sup>2</sup> h)
	Ref (s)	UUC (s)	Ref (Pa <sup>2</sup> h)	UUC (Pa <sup>2</sup> h)	Error (Pa <sup>2</sup> h)		
FAST / A : 60-140							
Calibrator Setting							
4000 Hz ± 95 dB	2846	2846	1.00	1.00	0.00	0.01	-0.29 - 0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref (s)	UUC (s)	Ref (Pa <sup>2</sup> h)	UUC (Pa <sup>2</sup> h)	Error (%)		
PAST 'A' 60-140							
Calibrator Setting							
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00		-21 - +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00	3.0	-21 - +41
Burst 1 ms, 108 dB	143	143	1.00	1.01	+1.00		-21 - +41

### 5. Response to unipolar pulse

UUC Setting	Time	Exposure Measurement		UNCERTAINTY (%)	Tolerances Limit (%)
		UUC (s)	UUC (P <sub>2</sub> h)		
FAST / A / 60-140	7		10.96	2.4	-21 - +26
Calibrator Setting			10.86		
Continuous Rectangle +					
Continuous Rectangle -					

\* Indicates non accredited

**End of Certificate**

### 3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting		FAST : A / High												
10000 Hz	Ref	(dB)	60.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0			
	Level A	(dB)	60.3	80.4	90.1	100.0	110.0	114.0	120.0	130.0	140.0			
	Error	(dB)	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
8000 Hz	Ref	(dB)			86.9	96.9	106.9	112.9	116.9	126.9	136.9			
	Level A	(dB)			88.9	98.9	108.9	112.9	116.9	126.9	136.9			
	Error	(dB)			0.0	0.0	0.0	0.0	0.0	0.0	-0.1			
63 Hz	Ref	(dB)												
	Level A	(dB)						87.8	93.8	103.8	113.8			
	Error	(dB)						87.8	93.8	103.8	113.8			
Tolerances Limit		( $\pm$ dB)											1.0	
UNCERTAINTY		( $\pm$ dB)											0.27	

**b. Sound exposure meter linearity of error**

UUC Setting		Time		Exposure Measurement			UNCERTAINTY	Tolerances
		Ref (s)	UUC (s)	Ref (Pa h) <sup>3</sup>	UUC (Pa h) <sup>3</sup>	Error (%)	(%)	Limit (%)
	FAST / A / 60-140							
	Calibrator Setting							
	1000 Hz 110 dB	27	27	0.30	0.30	0.00		
	1000 Hz 110 dB	45	45	0.50	0.50	0.00		
	1000 Hz 110 dB	90	90	1.00	0.99	-1.00	4.3	
	1000 Hz 110 dB	180	180	2.00	1.98	-1.00		
	1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
	1000 Hz 120 dB	72	72	8.00	8.05	+0.63		-21, +26
	1000 Hz 120 dB	90	90	10.00	10.13	+1.30	3.8	
	1000 Hz 120 dB	180	180	20.00	20.22	+1.10		
	1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
	1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

Certificate No	: 22-ACCT-534
Request No	: Req-2022-1571

Note: Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 36, SN, 107224

Z: Frequency weightings	UIC Setting	Deviation from various Frequency Weighting			UNCERTAINTY ( $\pm$ dB)	Tolerances Limit ( $\pm$ dB)
		A		C		
		(dB)	(dB)	(dB)		
	FAST / 60-140					
	STD Setting					
	*63 Hz	0.3	0.3	0.40	2.0	
	125 Hz	-0.6	-0.7	0.40	1.5	
	250 Hz	-0.1	-0.1	0.40	1.5	
	500 Hz	0.0	0.0	0.40	1.5	
	1000 Hz	0.0	0.0	0.40	-	
	2000 Hz	-0.4	-0.4	0.40	2.0	
	4000 Hz	-0.3	-0.3	0.40	3.0	
	8000 Hz	-0.8	-0.9	0.40	5.0	

the  $\alpha$ -level of confidence is maintained by the Coverage Factor  $k = 7$  providing a level of confidence approximately 95 %.

Mr. Noppadon Luangart  
Calibration Officer

Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
22 August 2022

Issue Date:

22 August 2022

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

**เอกสารแนบฉบับนี้**

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

**เอกสารไม่ออกคุณ**

วันที่ 01/07/19



### Calibration Note

: Nat Adjust

**Certificate No : 23-TPM-051**

Request No : Req-2023-0050

Page: 2/2

**Result of Calibration :**

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (±°C)
WET	20.004	20.2	- 0.2	0.14
	25.003	25.2	- 0.2	0.14
	30.003	30.2	- 0.2	0.14
	35.002	35.2	- 0.2	0.14
	40.005	40.2	- 0.2	0.14
	45.004	45.2	- 0.2	0.14
DRY	50.006	50.2	- 0.2	0.14
	60.006	60.2	- 0.2	0.14
	20.003	20.1	- 0.1	0.14
	25.006	25.1	- 0.1	0.14
	30.005	30.1	- 0.1	0.14
	35.005	35.1	- 0.1	0.14
GLOBE	40.006	40.1	- 0.1	0.14
	45.007	45.1	- 0.1	0.14
	50.005	50.1	- 0.1	0.14
	60.006	60.1	- 0.1	0.14
	20.005	20.1	- 0.1	0.14
	25.005	25.1	- 0.1	0.14
GLOBE	30.004	30.1	- 0.1	0.14
	35.003	35.1	- 0.1	0.14
	40.005	40.1	- 0.1	0.14
	45.006	45.1	- 0.1	0.14
	50.005	50.1	- 0.1	0.14
	60.003	60.1	- 0.1	0.14

End of Certificate

Calibrated By: \_\_\_\_\_

Mr. Sittichok Jirapukdeesakun

**Approved By :**

MAYOTT

Calibration Engineer Supervisor

**Issue Date :**

25 January 2023

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

**Reference Standard :**

08000057. ID: 02-TPM Which was calibrated on 10 March 2022. Calibration Certificate No.: QR22-0578

**Traceability**

Calibration 0292

### Note

**Certificate of Calibration**  
Customer : UNITED ANALYST AND ENGINEERING  
Name : CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong,  
Bangkok 10260  
Certificate No : 22-TPM-299  
Request No : Req-2022-1240  
Page : 1/2

**Certificate of Calibration**  
Customer : UNITED ANALYST AND ENGINEERING  
Name : CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong,  
Bangkok 10260  
Certificate No : 22-TPM-299  
Request No : Req-2022-1240  
Page : 2/2

**Unit Under Calibration Details**  
Calibration Parameter : Temperature  
Instrument Name : Thermal Environment Monitor  
Manufacturer : Quest Technologies  
Model : QT-34  
Serial Number : TEB060015  
Resolution : 0.1 °C  
ID Number : UAE.EMA2.057/2552  
Range Calibration : 20 °C to 60 °C  
Type of Sensor : RTD  
Sensor Diameter (mm) : 4.5  
Calibration Position (mm) : 67.5  
Instrument Status : Used

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (k=2)
WET	20.003	20.2	-0.2	0.14
	25.006	25.2	-0.2	0.14
	30.004	30.2	-0.2	0.14
	35.003	35.2	-0.2	0.14
	40.006	40.1	-0.1	0.14
	45.005	45.1	-0.1	0.14
DRY	50.006	50.1	-0.1	0.14
	60.007	60.1	-0.1	0.14

**Calibration Environment and Details**  
Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 15 %RH  
Received Date : 11 July 2022  
Calibrated Date : 26 July 2022  
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

DRY	20.004	20.1	-0.1	0.14
	25.003	25.1	-0.1	0.14
	30.008	30.1	-0.1	0.14
	35.005	35.1	-0.1	0.14
	40.005	40.0	0.0	0.14
	45.004	45.0	0.0	0.14
GLOBE	50.005	50.0	0.0	0.14
	60.005	60.0	0.0	0.14

**Reference Standard** : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model GT11/RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 10 March 2022, Calibration Certificate No : QR22-0578  
**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 %.

GLOBE	20.003	20.1	-0.1	0.14
	25.003	25.1	-0.1	0.14
	30.005	30.1	-0.1	0.14
	35.006	35.1	-0.1	0.14
	40.004	40.0	0.0	0.14
	45.007	45.0	0.0	0.14
GLOBE	50.004	50.0	0.0	0.14
	60.007	60.0	0.0	0.14

**End of Certificate**  
Approved By :  
Mr. Pacit Mathavom  
Calibration Engineer Supervisor  
Issue Date : 26 July 2022

**End of Certificate**  
Calibrated By :  
Mr. Sin  
Kun  
End of Certificate

## Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
Certificate No : 22-AFM-157  
Request No : Req-2022-1825  
Name :  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

### Unit Under Calibration Details

Measurement Item : Mass flow meter  
Manufacturer : TSI  
Model : 4146  
Serial Number : 41461923008  
ID : UAE.EFM.2242562  
Location of Calibration : LAB 4 AIR VELOCITY METER

### Calibration Environment and Details

Temperature : (23 ± 3) °C  
Humidity : (55 ± 15) %RH  
Barometric Pressure : (1010 ± 10) hpa  
Received Date : 3 October 2022  
Calibration Date : 4 October 2022

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	16 June 2023
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	15 June 2023

### 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 %.

Calibration By :

Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :

N. vorn

Calibration Engineer Supervisor

Issue Date : 4 October 2022

Certificate No : 22-AFM-157  
Request No : Req-2022-1825

### Result of Calibration :

Flow Setting	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
cc/min	cc/min	cc/min	cc/min	cc/min
20	20.09	17	3.09	0.64
50	49.94	47	2.94	0.91
100	99.9	98	1.9	1.8
200	199.8	196	3.8	3.6
500	500.7	492	8.7	7.1

### Note

STD : Standard

UUC : Unit Under Calibration

Calibration media : Air

\* Indicates non accredited

End of Certificate

Certificate No : 22-AFM-156  
Request No : Req-2022-1825

Result of Calibration :

Flow Setting	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
LPM	LPM	LPM	LPM	LPM
1.0	1.002	0.984	0.018	0.015
1.7	1.703	1.673	0.030	0.025
2.0	2.002	1.965	0.037	0.029
3.0	3.003	2.964	0.039	0.043
4.0	4.008	3.957	0.051	0.057
5.0	5.010	4.943	0.067	0.071

Note

- STD : Standard  
UUC : Unit Under Calibration  
Calibration media : Air  
♦ Indicates non accredited

End of Certificate

Certificate of Calibration

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

Unit Under Calibration Details

Measurement Item : Mass flow meter  
Manufacturer : TSI  
Model : 4146  
Serial Number : 41461922008  
ID : UAE.BFM.224/2562

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : (23 ± 3) °C  
Humidity : (55 ± 15) %RH  
Barometric Pressure : (1010 ± 10) hpa  
Received Date : 3 October 2022  
Calibration Date : 4 October 2022

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Standard flow	21151012015	Sensidyne	15 June 2023
Air Flow Meter	Gilibrator 3 High Flow	18501012012	Sensidyne	15 June 2023

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 %.

Calibration By :

Mr. Noppadon Luangrit  
Service Calibration Engineer

Approved By :

Mr. Pait Malhavorn

Calibration Engineer Supervisor

Issue Date :

4 October 2022





Cert.No.: 22P2723  
Page: 2 of 2

Result of calibration:- Without adjustment  
Function:- Absolute Pressure Measurement  
Range: 720 mmHg to 770 mmHg  
Scale Interval: 1 mmHg ( The Fifth Estimate )

Increasing Pressure					
Applied Pressure (mmHg)	717.72	728.35	738.91	749.90	761.32
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0
Error (mmHg)	2.28	1.65	1.09	0.10	-1.32
Decreasing Pressure					
Applied Pressure (mmHg)	771.89	761.01	749.89	738.88	728.25
UUC* Indication (mmHg)	770.0	760.0	750.0	740.0	730.0
Error (mmHg)	-1.89	-1.01	0.11	1.12	1.75

The uncertainty of measurement was  $\pm 0.24$  mmHg  
\* 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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/44 PATTANAKARN ROAD SOI 18, SUANILUANG, SUANILUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484

## Certificate of Calibration

Certificate No. : 22P2723  
Page : 1 of 2

Equipment : Aneroid Barometer

Manufacturer: Barigo

Model : 111MS

Serial No.:

ID No.: UAE.EMA2.066/2552

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022

Reference: 2207-0504/WSG

Ambient Temperature: (  $23 \pm 2$  ) °C

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

Atmospheric Pressure: 1010 mbar

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phraekhanong, Bangkok 10280

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using "DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

#### Instrument

1) Standard Barometer

Model  
DP1142

Serial No.  
1422505046

Certificate No.  
MP-0076-22

Due Date  
02 May 2023

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.Scale and conversion factor is 1 kPa = 7.50062 mmHg

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

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

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

8.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussaree  
Issue Date : 26 July 2022

Approved Signatory :

[ ] Phalinee Prabpaijal

[ ] Sura Suwannasri

[x] Atapol Panurach

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a 1118532

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เอกสารไมควบคุม  
B 0293206



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Cert. No.: 22H1986  
Page.: 2 of 2

## Certificate of Calibration

Certificate No.: 22H1986  
Page: 1 of 2

### Result of Calibration:- Function:

Humidity measurement.  
Without Adjustment

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	43.8	3.7	1.3
25.0	50.1	53.6	3.5	1.6
25.0	60.0	63.1	3.1	1.6
25.0	70.2	72.2	2.0	1.6

### Result of Calibration:- Function:

Temperature measurement.  
Without Adjustment

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
15.02	15.0	-0.02	0.42
20.03	20.0	-0.03	0.42
25.02	24.9	-0.12	0.42
30.03	29.9	-0.13	0.42
40.03	39.7	-0.33	0.42

### UUC\* : Unit Under Calibration

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

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Equipment:

Digital Thermo-Hygrometer

Manufacturer:

Tesio

Model:

608-H1

Serial No.:

34843154

ID No.:

UAE.ANV.133-2550

Condition As-Received:

Used Item

Received Date:

21 September 2022

Calibration Date:

23 September 2022

to 27 September 2022

Reference:

2209-0729WSC

Ambient Temperature:

( 25 ± 3 ) °C

Relative Humidity:

( 50 ± 20 ) %

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

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

Procedure used:

Calibration was conducted using In-house calibration procedure CP-H03 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) Hygro-M2 Dew Point Monitor

5112

2360195

20703

02 Aug 2023

2) Standard Humidity/Temperature Meter

400

10240757

TH-0125-21

13 Dec 2022

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 at:-

-National Institute of Standards and Technology (NIST), The United States of America

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Viporn Tantiyawutti  
Issue Date: 29 September 2022

Approved Signatory:

[ ] Chakrit Waewanyan  
[ ] Ponthippa Tameyakul  
[ ] Viporn Tantiyawutti

เอกสารไม่ควบคุม  
a 1128760

เอกสารไม่ควบคุม  
B 0298127