

ภาคผนวก ง  
เอกสารสอบเทียบเครื่องมือ

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บัญชีรายการเครื่องมือหลักของห้องปฏิบัติการ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือสำหรับวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองรวม (TSP) ฝุ่นละอองขนาดเล็กเกิน 10 ไมครอน	Mettler-Toledo	AB204-S / 1128312528	Technology Promotion Association (Thailand-Japan)	23MM1331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)	(PM-10)		AB204-S/FACT / B108115858	Technology Promotion Association (Thailand-Japan)	23MM1332	7 Apr 23	5 Apr 24	-

Due Date of Calibration\* : Schedule the program once a year at least once a year.

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration
Ambient								
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Andersen Instruments, Inc.	G25A 11MX	Tisch Environmental, Inc.	28062022	28 Jun 21	27 Jun 23
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	22P918	11 Jul 22	10 Jul 23
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2722	22 Jul 22	21 Jul 23
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1587	27 Jul 22	26 Jul 23
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 42C-0508011076	UAE Consultant Co.,Ltd.	18032023	18 Mar 23	17 Mar 24
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Fisher Scientific	42C 0517512000	UAE Consultant Co.,Ltd.	16032023	16 Mar 23	15 Mar 24
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 0517512001	UAE Consultant Co.,Ltd.	20042023	20 Apr 23	19 Apr 24
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM08130002	UAE Consultant Co.,Ltd.	11012023	11 Mar 23	10 Jan 24
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1182920007	UAE Consultant Co.,Ltd.	03052023	3 May 23	2 May 24
10	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-0607415779	UAE Consultant Co.,Ltd.	03052023	3 May 23	2 May 24
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-0611116459	UAE Consultant Co.,Ltd.	07042023	7 Apr 23	6 Apr 24
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43TLC-78567-389	UAE Consultant Co.,Ltd.	19042023	19 Apr 23	18 Apr 24

## List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration
<b>Ambient</b>								
14	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-62236-334	UAE Consultant Co.,Ltd.	03052023	3 May 23	2 May 24
15	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	42i 1182920013	UAE Consultant Co.,Ltd.	01032023	1 Mar 23	28 Feb 24
16	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24
17	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040002	Thai Meteorological Department	275/22	2 Aug 22	1 Aug 23
18	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040005	Thai Meteorological Department	259/22	12 Jul 22	11 Jul 23
19	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20080022	Thai Meteorological Department	262/22	12 Jul 22	11 Jul 23
20	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040026	Thai Meteorological Department	261/22	12 Jul 22	11 Jul 23
21	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040039	Thai Meteorological Department	260/22	12 Jul 22	11 Jul 23
22	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Larson Davis	CAL150 6458	Innovative Instrument Co.,Ltd.	22-ACT-371	8 Jun 22	7 Jun 23
23	Sound Level Meter	$L_{Aeq} 24\text{ hours}$ , $L_{A90}$ , $L_{Amax}$ , $L_{Adn}$ , $L_{Aeq} 5\text{ min}$	Larson Davis	LxT2 0005405	Innovative Instrument Co.,Ltd.	22-ACT-101	11 Feb 22	10 Feb 24
24	Sound Level Meter	$L_{Aeq} 24\text{ hours}$ , $L_{A90}$ , $L_{Amax}$ , $L_{Adn}$ , $L_{Aeq} 5\text{ min}$	Larson Davis	LxT2 0005407	Innovative Instrument Co.,Ltd.	22-ACT-037	21 Jan 22	20 Jan 24
25	Sound Level Meter	$L_{Aeq} 24\text{ hours}$ , $L_{A90}$ , $L_{Amax}$ , $L_{Adn}$ , $L_{Aeq} 5\text{ min}$	Larson Davis	LxT2 0006692	Larson Davis-A PCB Piezotronics Div.	2022003094	11 Mar 22	10 Mar 24





# Certificate of Calibration

RECALIBRATION DUE DATE:
June 28, 2022

Calibration Certification Information			
Cal. Date: June 28, 2021	Rootsometer S/N: 438320	Ta: 297 °K	
Operator: Jim Tisch		Pa: 753.6 mm Hg	
Calibration Model #: G25A	Calibrator S/N: 11MX		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3910	3.3	2.00
2	3	4	1	0.9890	6.4	4.00
3	5	6	1	0.8850	8.0	5.00
4	7	8	1	0.8430	9.0	5.50
5	9	10	1	0.6970	12.9	8.00

Data Tabulation			
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \times \frac{Tstd}{Ta} \right)}$ (y-axis)	Qa (x-axis)
0.9906	0.7121	1.4106	0.9956
0.9865	0.9975	1.9949	0.9915
0.9844	1.1123	2.2304	0.9894
0.9831	1.1661	2.3393	0.9881
0.9779	1.4030	2.8213	0.9829
QSTD	m= 2.04215 b= -0.04258 r= 1.00000	QA	m= 1.27876 b= -0.02680 r= 1.00000

Calculations	
Vstd=ΔVol/(Pa-ΔP)/(Pstd)(Tstd/Ta)	Va=ΔVol/((Pa-ΔP)/Pa)
Qstd=Vstd/ΔTime	Qa=Va/ΔTime
For subsequent flow rate calculations:	
Qstd= $\frac{1}{m} \left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \times \frac{Tstd}{Ta} \right)} - b \right)$	Qa= $\frac{1}{m} \left( \sqrt{\Delta H \left( \frac{Ta}{Pa} \right)} - b \right)$

Standard Conditions	
Tstd: 298.15 °K	
Pstd: 760 mm Hg	
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: rootsometer manometer reading (mm Hg)	
Ta: actual absolute temperature (°K)	
Pa: actual barometric pressure (mm Hg)	
b: intercept	
m: slope	

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484

## Certificate of Calibration

Certificate No. : 22P918  
Page : 1 of 2

Equipment : U Tube Manometer  
Manufacturer: Dwyer  
Model : 1221-36-W/M  
Serial No.:  
ID No.: UAE.EFM.180/2561  
Condition As-Received: Used Item  
Received Date: 01 July 2022  
Calibration Date: 11 July 2022

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

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

Reference: 2202-0083W/SC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1012 mbar

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments  
Standard according to in-house calibration procedure CP-P04, 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	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0113-22	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 Phongam  
Issue Date : 11 July 2022

Approved Signatory : *Attapol P.*

[ ] Phalinee Prabpaipal  
[ ] Sura Suwamasri  
[x] Attapol Panurach

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B 0250402



Cert.No.: 22P918  
Page: 2 of 2

Result of calibration:- Without adjustment  
Function:- Pressure Measurement  
Scale Interval : 0.1 inH<sub>2</sub>O ( The Fifth Estimate )  
Range : 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O

Applied Pressure (inH <sub>2</sub> O)	UUC Indication		ΔP (inH <sub>2</sub> O)	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	0.00
2.00	1.00	-1.02	2.02	0.02
4.00	2.00	-2.00	4.00	0.00
6.00	3.02	-2.98	6.00	0.00
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.02	-6.00	12.02	0.02
14.00	7.00	-6.98	13.98	-0.02
16.00	8.00	-7.98	15.98	-0.02
18.00	9.00	-9.02	18.02	0.02
20.00	10.00	-10.02	20.02	0.02
22.00	11.00	-11.02	22.02	0.02
24.00	11.98	-12.00	23.98	-0.02
26.00	12.98	-13.04	26.02	0.02
28.00	13.98	-14.04	28.02	0.02
30.00	14.98	-15.04	30.02	0.02
32.00	15.98	-16.06	32.04	0.04
34.00	17.00	-17.06	34.06	0.06
35.50	17.78	-17.94	35.72	0.22

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 %.

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Attapol P.

เอกสารในควบคุม  
a 1037939





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NSC-TIS-TIS17025  
CALIBRATION 0008

## Certificate of Calibration

Certificate No. : 22P2722  
Page : 1 of 2

**Equipment:** Aneroid Barometer  
**Manufacturer:** Barigo  
**Model:** -  
**Serial No.:** -  
**ID No.:** UAE.ANV.013/2547  
**Condition As-Received:** Used Item  
**Received Date:** 20 July 2022  
**Calibration Date:** 22 July 2022  
**Reference:** 2207-0584WSC  
**Ambient Temperature:** ( 23 ± 2 ) °C  
**Relative Humidity:** ( 50 ± 15 ) %  
**Atmospheric Pressure:** 1010 mbar

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phraekhanong, 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	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	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.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 Aussarree  
**Issue Date :** 25 July 2022

**Approved Signatory :** Attapol P.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwamasri  
[x] Attapol Panurach

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B 0293205



Cert.No.: 22P2722  
Page: 2 of 2

**Result of calibration:- Without adjustment**  
**Function:- Absolute Pressure Measurement**  
**Range:** 720 mmHg to 780 mmHg  
**Scale Interval:** 1 mmHg ( The Fifth Estimate )

Increasing Pressure							
Applied Pressure (mmHg)	718.46	729.33	739.85	750.22	760.90	772.01	785.89
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0
Error (mmHg)	1.54	0.67	0.15	-0.22	-0.90	-2.01	-5.89

Decreasing Pressure							
Applied Pressure (mmHg)	785.90	771.99	760.85	750.17	739.90	729.57	718.62
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-5.90	-1.99	-0.85	-0.17	0.10	0.43	1.38

The uncertainty of measurement was ± 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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a 1118533



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## Certificate of Calibration

Certificate No.: 22H1587  
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer  
Manufacturer: Barigo  
Model: -  
Serial No.: UAE.ANV.127/2550  
ID No.:  
Condition As-Received: Used Item  
Received Date: 20 July 2022  
Calibration Date: 22 July 2022 to 27 July 2022  
Reference: 2207-0568WSC  
Ambient Temperature: ( 25 ± 3 ) °C  
Relative Humidity: ( 50 ± 20 ) %

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

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

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

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

### Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) 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 Certificate 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:

[✓] Chakrit Waewanjua  
[ ] Porntippa Tameyakul  
[ ] Viporn Tantiyawutti

*Chakrit Waewanjua*

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B 0293723



Cert. No.: 22H1587  
Page.: 2 of 2

Result of Calibration:-			
Function:	Before Adjustment		Uncertainty of Measurement (±%R.H.)
	Reference Temperature (°C)	Humidity Standard Humidity (%R.H.) UUC* Reading (%R.H.) Error (%R.H.)	
Humidity measurement.	25.0	40.1	1.6
	25.0	60.0	1.8
	25.0	80.0	2.0

Result of Calibration:-			
Function:	After Adjustment		Uncertainty of Measurement (±%R.H.)
	Reference Temperature (°C)	Humidity Standard Humidity (%R.H.) UUC* Reading (%R.H.) Error (%R.H.)	
Humidity measurement.	25.0	40.1	1.6
	25.0	60.0	1.8
	25.0	80.0	2.0

Result of Calibration:-			
Function:	Without Adjustment		Uncertainty of Measurement (±°C)
	Standard Temperature (°C)	UUC* Reading (°C) Error (°C)	
Temperature measurement.	20.00	20.0	0.72
	25.04	25.0	0.72
	30.01	30.0	0.72
	35.04	35.0	0.72
	39.98	40.0	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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*Chakrit Waewanjua*

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B 1119773



## MULTI-POINT GAS TEST REPORT

Test Date : Mar 18, 2023

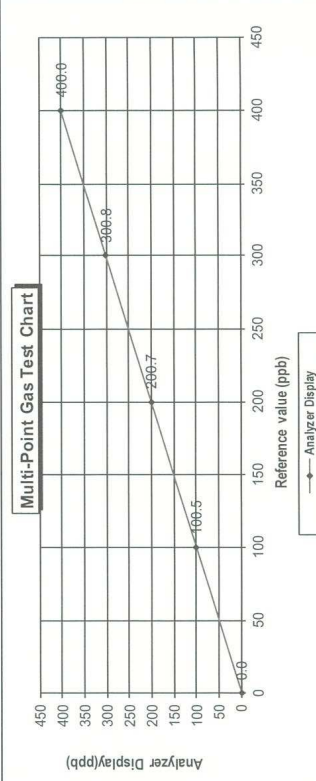
Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42C  
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

### Standard Gas Concentration

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

### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.5	0.50	0.50
Level 3	40.00%	200.0	200.7	0.35	0.35
Level 4	60.00%	300.0	300.8	0.27	0.27
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range 500.0 ppb			Average Difference (%)		
:Acceptable Limit $\pm$ 5%			0.22		



Calculate by

Apichwat K.  
18/3/66

Approve by

Apichwat K.  
18/3/66

## MULTI-POINT GAS TEST REPORT

Test Date : Mar 16, 2023

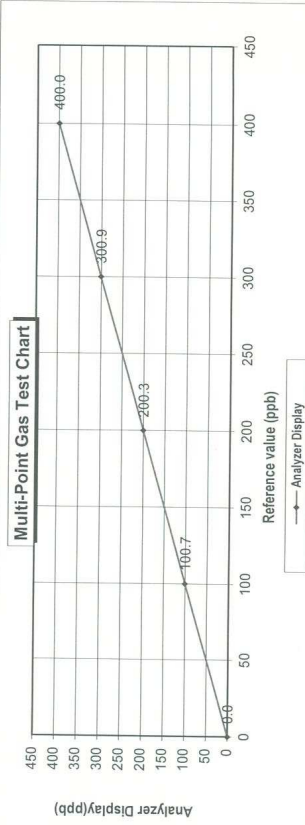
Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42C  
Manufacturer : Thermo Electron Corporation Serial Number : 0517512000

### Standard Gas Concentration

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

### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70
Level 3	40.00%	200.0	200.3	0.30	0.15
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range 500.0 ppb			Average Difference (%)		
:Acceptable Limit $\pm$ 5%			0.23		



Calculate by

Apichwat K.  
16/3/66

Approve by

Apichwat K.  
16/3/66

## Multi-Point Gas Test Report

Test Date : Apr 20, 2023

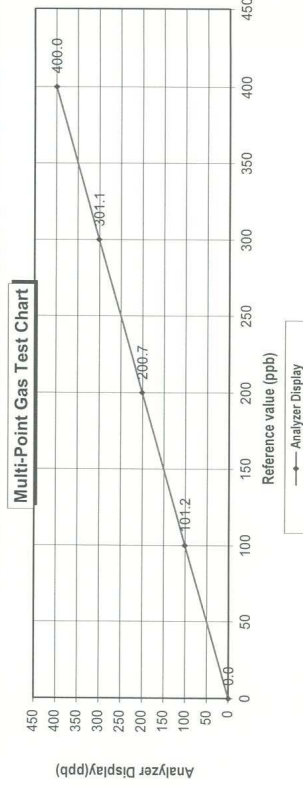
Equipment : Gas Analyzer (NO<sub>2</sub>)  
Manufacturer : Thermo Electron Corporation  
Model : 42C  
Serial Number : 0517512001

**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 21, 2024

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	101.2	1.20	1.19	1.19
Level 3	40.00%	200.7	0.70	0.35	0.35
Level 4	60.00%	301.1	1.10	0.37	0.37
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb Acceptable Limit $\pm$ 5%					0.38



Calculate by  
Adhawat K.  
20/4/2023

Approve by  
Pobharn K.  
20/4/2023

## Multi-Point Gas Test Report

Test Date : Jan 11, 2023

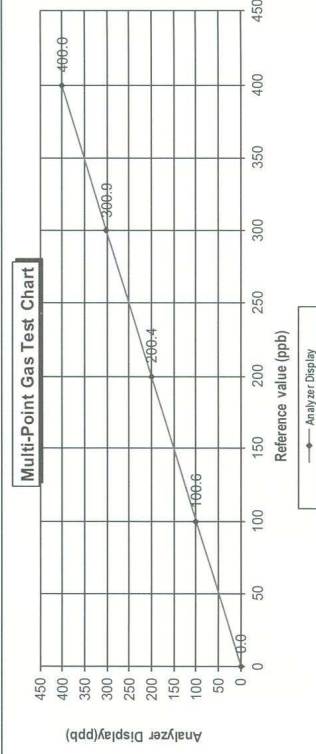
Equipment : Gas Analyzer (NO<sub>2</sub>)  
Manufacturer : Thermo Scientific  
Model : 42i  
Serial Number : CM08130002

**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 21, 2024

**Dilutor Detail**  
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

### Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.6	0.60	0.60	0.60
Level 3	40.00%	200.4	0.40	0.20	0.20
Level 4	60.00%	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb Acceptable Limit $\pm$ 5%					0.22



Calculate by  
Sithan Sangman  
11/1/2023

Approve by  
Pobharn K.  
11/1/2023



**MULTI-POINT GAS TEST REPORT**

Test Date : May 3, 2023

Equipment : Gas Analyzer (NO<sub>2</sub>)  
Manufacturer : Thermo Scientific

Model : 42i  
Serial Number : 1182920007

**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 21, 2024

**Dilutor Detail**

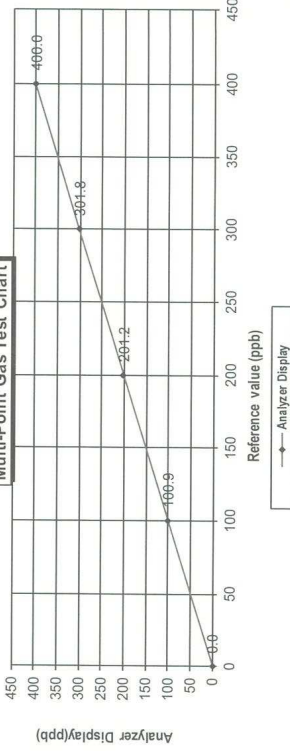
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

**Multi-point gas test data**

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.9	0.90	0.89	0.89
Level 3	40.00%	201.2	1.20	0.60	0.60
Level 4	60.00%	301.8	1.80	0.60	0.60
Level 5	80.00%	400.0	0.00	0.00	0.00
Average Difference (%)					0.42

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

**Multi-Point Gas Test Chart**



Calculate by

Aphawat K.  
3 May 2023

Approve by

3 May 2023

**CERTIFICATE OF ANALYSIS**  
**Grade of Product: EPA Protocol**

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1  
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF  
Laboratory: 124 - Durham (SAP) - NC Valve Pressure: 2015 PSIG  
PGVP Number: B22021 Valve Outlet: 660  
Gas Code: CO,NO,NO<sub>2</sub>,SO<sub>2</sub>,BALN Certification Date: Jun 21, 2021  
Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/531, using the assay methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. These uncertainties are calculated using the method of propagation of uncertainty and are on a mole/mole basis unless otherwise noted. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

**ANALYTICAL RESULTS**

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	$\pm 1.0\%$ NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	$\pm 0.7\%$ NIST Traceable	06/14/2021
NITROGEN	Balance				

**CALIBRATION STANDARDS**

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 02, 2025
PRM	12386	D885025	9.91 PPM NITROGEN DIOXIDE/AIR	$\pm 2.0\%$	Feb 20, 2023
GMIS	401423838102	CC505681	4.348 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 2.1$	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.8\%$	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.6\%$	Nov 15, 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 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO <sub>2</sub>	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO <sub>2</sub>	FTIR	Jun 03, 2021

Triad Data Available Upon Request

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



CERT 3082.01

เอกสารไม่ควบคุม

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

Approved for Release

### MULTI-POINT GAS TEST REPORT

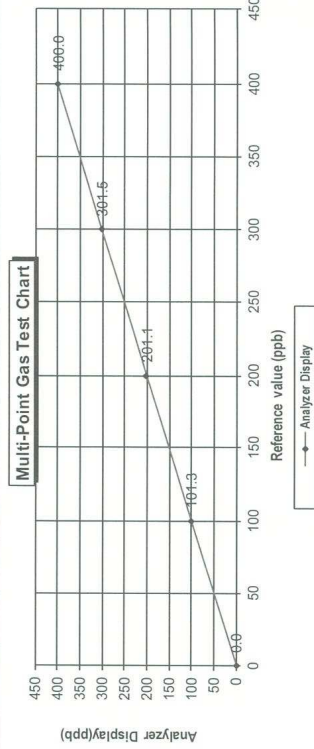
Test Date : May 3, 2023

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

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	146i
Methane (CH <sub>4</sub> )	-	PPM	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	0.00	0.00	0.00
Level 2 20.00%	101.3	1.30	1.28	1.28
Level 3 40.00%	201.1	1.10	0.55	0.55
Level 4 60.00%	301.5	1.50	0.50	0.50
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		
:Acceptable Limit ± 5%		Average Difference (%)		0.47



Calculate by

Aphiwat K.  
3 May 2023

Approve by

Aphiwat K.  
3 May 2023

### MULTI-POINT GAS TEST REPORT

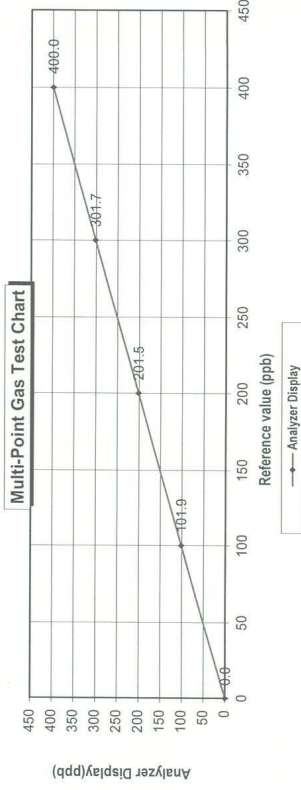
Test Date : Apr 7, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Electron Corporation Serial Number : 43C-0611116459

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	146i
Methane (CH <sub>4</sub> )	-	PPM	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	0.00	0.00	0.00
Level 2 20.00%	101.9	1.90	1.86	1.86
Level 3 40.00%	201.5	1.50	0.74	0.74
Level 4 60.00%	301.7	1.70	0.56	0.56
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb		
:Acceptable Limit ± 5%		Average Difference (%)		0.63



Calculate by

Aphiwat K.  
7 Apr 2023

Approve by

Aphiwat K.  
7 Apr 2023





### Multi-Point Gas Test Report

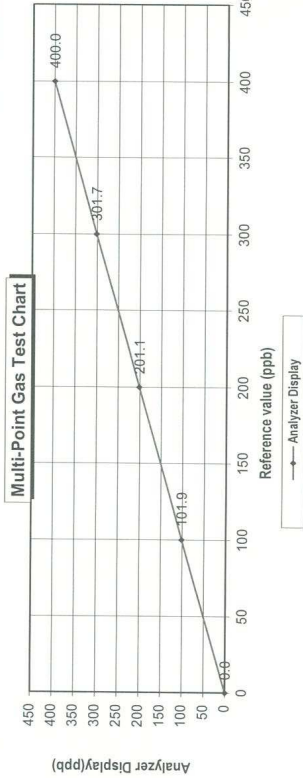
Test Date : Apr 19, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Environmental Instruments Serial Number : 43CTL-78567-389

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	1461
Methane (CH <sub>4</sub> )	-	PPM	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 0.0	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	1.90	1.86	0.00
Level 3 40.00%	200.0	1.10	0.55	0.55
Level 4 60.00%	300.0	1.70	0.56	0.56
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb		Average Difference (%)		0.60
:Acceptable Limit ± 5%				



Calculate by  
Aphiwat K.  
9/4/16

Approve by  
Paton u  
19 Apr 2023

### Multi-Point Gas Test Report

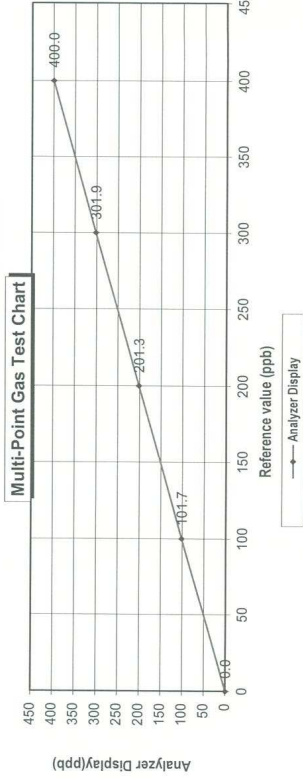
Test Date : May 3, 2023

Equipment : Gas Analyzer (SO<sub>2</sub>) Model : 43C  
Manufacturer : Thermo Environmental Instruments Serial Number : 43C-62236-334

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO <sub>2</sub> )	44.68	PPM	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	1461
Methane (CH <sub>4</sub> )	-	PPM	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 0.0	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	101.7	1.70	1.67
Level 3 40.00%	200.0	201.3	1.30	0.65
Level 4 60.00%	300.0	301.9	1.90	0.63
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb		Average Difference (%)		0.59
:Acceptable Limit ± 5%				



Calculate by  
Aphiwat K.  
9/5/16

Approve by  
Paton u  
3 May 2023

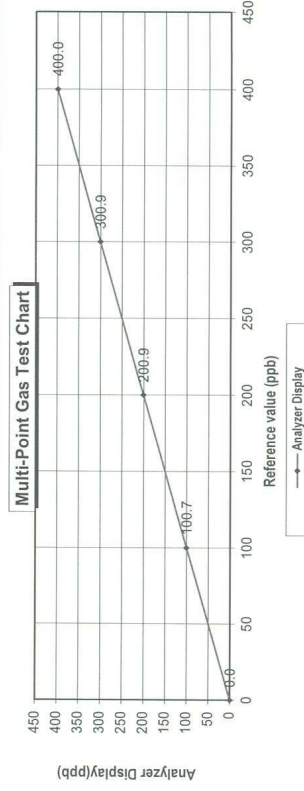
1182920013

Expiration Date :

Multi-point gas test data

Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	% Error ]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	0.70	0.70	0.70
Level 3	40.00%	200.0	0.90	0.45	0.45
Level 4	60.00%	300.0	0.90	0.30	0.30
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range		500.0 ppb	Average Difference	(%)	0.29

k : Measuring Range  
:Acceptable Limit + 5%



**Calculate by**

Arbitrat: K

29/3/20

Approve by \_\_\_\_\_

1/2 Morn in

1, Nov, 2023



## 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 : Dato Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : Dato Logger 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 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 0 - 20 m/sec

Calibrated by :

Signed :

Mr. Watcharapol Subwat

Mr. Pisod Promsut

Mechanical Engineer



## 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 H2O	Vacuum inches H2O	Velocity m/sec	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. Watcharapol Subwat

Mechanical Engineer





# THAI METEOROLOGICAL DEPARTMENT

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



## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 12 July, 2022

Certification No. 259/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

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

Serial No. : Dato 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, Prakanong, 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 120629586)

### JAPAN QUALITY ASSURANCE ORGANIZATION



Calibrated by : Signed :  
Mr. Watchapol Subwat Mr. Pisood Plomsut  
Mechanical Engineer Mechanical Engineer

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# THAI METEOROLOGICAL DEPARTMENT

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



## The Result of Calibration

Certification No. 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	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.

### 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



เอกสารไม่ควบคุม

## THAI METEOROLOGICAL DEPARTMENT

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



## Calibration Certificate

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

Date of Issue 12 July, 2022

Certification No. 262/22

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 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 m/sec

Calibrated by :  Signed :   
Mr. Watcharapol Subwat Mr. Pised Pomsut  
Mechanical Engineer



เอกสารไม่ควบคุม



## THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 262/22

Page : 2 of 2


12 July, 2022

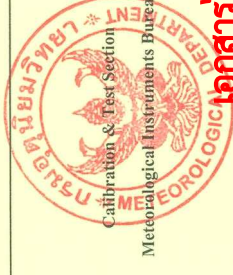
Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.7	0.30
3.02	-	-	-	2.5	0.52
5.00	-	-	-	4.2	0.80
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.7	0.32
11.01	-	-	-	10.5	0.51
13.01	-	-	-	12.7	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. Watcharapol Subwat  
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 Pilot Tube Theodor Friedrichs Type 0800.0000 serial 9023

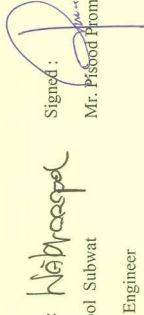
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

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

Serial Number 110730029 (sensor 120629586)

## JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 0 - 20 m/sec

Calibrated by :  Signed :  
Mr. Watcharapol Subwat  
Mechanical Engineer



## 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 H2O	Vacuum Inches H2O	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.

## U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :



Mr. Watcharapol Subwat  
Mechanical Engineer



เอกสารนี้มีความ



## Calibration Certificate



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

Date of Issue 12 July, 2022

Certification No. 260/22

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. : 20040039 wind speed and wind direction 20040180  
ID No. : No.10/20

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1004.8 hPa

## NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

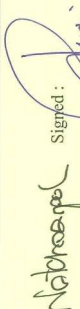
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 0 - 20 m/sec

Calibrated by :  Signed :  
Mr. Watcharapol Subwat Mr. Pisood Promsutt  
Mechanical Engineer



เอกสารไม่ควบคุม

## The Result of Calibration

Certification No. 260/22

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	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.6	0.40
3.02	-	-	-	2.5	0.52
5.00	-	-	-	4.0	1.00
7.04	-	-	-	6.4	0.64
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.6	0.41
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.6	0.42

Wind Aloft Plotting Board.

## US. DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :



Mr. Watcharapol Subwat  
Mechanical Engineer



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## Certificate of Calibration

### Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260  
Certificate No : 22-ACT-101  
Request No : Req-2022-0231

### Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : LxT2  
Serial Number : 0005405  
ID : UAE.EFM.041/2564  
Resolution : 0.1 dB  
Microphone Model : 375A04  
Microphone S/N : 329360  
Preamplifier Model : PRLMxT2C  
Preamplifier S/N : 073800  
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 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic


### Reference Standard

Instrument	Brand	Model	SN.	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	15 September 2022	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	14 June 2022	TSI
Audio Generator	SvanteK	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. Pacit Madhavorn  
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

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

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Certificate No : 22-ACT-101  
Request No : Req-2022-0231

### 1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	Adjust	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	Level (dB)	UUC (dB)	ERR (dB)	ERR (dB)	( ± dB)
Calibrator Setting					
1000 Hz 114.00 dB	113.85	113.9	+0.05	113.9	0.20
				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		
A	27.3	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		
A	27.6	0.10
C	27.3	0.10
Z	33.2	0.10

### 4. Acoustic signal test of frequency weightings

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance Limit
FAST / 37-139	Weighting Response curve	UNCERTAINTY	Limit
STD Setting	A (dB)	C (dB)	Z (dB)
125 Hz	0.0	0.1	0.1
1000 Hz	0.0	0.0	0.0
4000 Hz	0.2	0.2	0.2
8000 Hz	-0.1	-0.1	0.0
			0.70
			2.0
			1.0
			3.0
			5.0

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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 (± dB)	Acceptance Limit (± dB)
	FAST / A / 37-139	REF (dB)	UUC (dB)	ERR (dB)		
STD dB	139.00	139	139.0	0.0	0.3	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	74.0	0.0		1.1
	69.00	69	69.0	0.0		1.1
	64.00	64	64.1	0.1		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
	38.00	38	38.4	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 (± dB)	Acceptance Limit (± dB)
		Weighting Response curve				
FAST / 37-139	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	0.0	0.0		2.0
	4000 Hz	0.0	0.0	0.0		3.0
	8000 Hz	0.0	0.0	0.0		5
	16000 Hz	-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)		
FAST / 37-139	UUC Weighting	114.00	114.0	0.2	0.2
					0.2
		114.00	114.0		0.2
		114.00	114.0	0.0	0.1
		114.00	114.0	0.0	0.1
		114.00	114.0	0.0	0.1

Certificate No : 22-ACT-101  
Request No : Rsp-2022-0231

12. Overload indication

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 37-139	UUC (dB)		
STD Setting			
Positive one-half cycle	141.8		
Negative one-half cycle	141.9		
Deviated	-0.1	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± 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

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Certificate No : 22-ACT-101  
Request No : Rsp-2022-0231

9. Level linearity including the level range control

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

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
A / 37-139	Toneburst (ms)	Ref (dB)	UUC (dB)	ERR (dB)	
UUC Time Response					
Fast	200	135.0	134.9	-0.1	1
	2	118.0	117.6	-0.4	+1.0, -2.5
	0.25	109.0	108.8	-0.2	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1
	2	109.0	108.8	-0.2	+1.0, -5.0
	200	129.0	129.0	0.0	1
SEL	2	109.0	109.0	0.0	+1.0, -2.5
	0.25	100.0	100.0	0.0	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± 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

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Certificate No : 22-ACT-037

Request No : Req-2022-0096

## 12. Overload indication

UUC Setting	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
FAST / A / 37-139	UUC		
STD Setting	(dB)		
Positive one-half cycle	142.9		
Negative one-half cycle	142.9		
Deviated	0.0	0.2	1.5

### 13. High Level Stability

UUC Setting	Measured		UNCERTAINTY ( $\pm$ dB)	Acceptance Limit
	FAST / A / 37-139	UUC (dB)		
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 ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
		REF (dB)	UUC (dB)	ERR (dB)			
	FAST / A						
	UUC Range						
		44.1	44.2	0.1		0.3	1.1
	37-139	114	114.0	0.0			1.1

## 10. Tone burst response

UUC Setting	STD Toneburst (ms)	Anticipated Ref (dB)	Measured		UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
			UUC (dB)	ERR (dB)		
A / 37-139	UUC Time Response	200	135.0	0.0		1
			117.7	-0.3		
			108.8	-0.2		
Fast	0.25	109.0	128.5	-0.1	0.3	+1.0, -2.5
			109.0	-0.1		
			108.9	-0.1		
Slow	200	129.0	129.1	+0.1		1
			108.9	-0.1		
			100.0	0.0		
SEL	2	109.0	108.9	-0.1		+1.0, -2.5
			100.0	0.0		
			100.0	0.0		

## 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	136.1	-0.30	0.2	2.0
Negative half cycle	136.4	136.2	-0.20		2.0

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

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date 01/07/19

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For use on: 068314401 Rev. 03 date 01.07.19



# Calibration Certificate

Certificate Number 2022003094

## Customer:

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

Model Number	LxT2	Procedure Number	D0001.8384
Serial Number	0006692	Technician	Jacob Cannon
Test Results	Pass	Calibration Date	11 Mar 2022
Initial Condition	As Manufactured	Calibration Due	
Description	SoundTrack LxT Class 2	Temperature	23.48 °C ± 0.25 °C
	Class 2 Sound Level Meter	Humidity	51.5 %RH ± 2.0 %RH
	Firmware Revision: 2.404	Static Pressure	87.17 kPa ± 0.13 kPa

## Evaluation Method

### Tested with:

Larson Davis CAL200, S/N 9079  
Larson Davis PRMLxT2C, S/N 071561  
PCB 375A04, S/N 335076  
Larson Davis CAL291, S/N 0108

## Compliance Standards

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

ANSI 60651:2001 Type 2  
ANSI S1.4-2014 Class 2  
IEC 60804:2000 Type 2  
ANSI S1.4 (R2006) Type 2  
IEC 61252:2002  
ANSI S1.11 (R2009) Class 2  
IEC 61260:2001 Class 2  
ANSI S1.25 (R2007)  
IEC 61672:2013 Class 2  
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  $\pm$  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

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Certificate Number 2022003094

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 (b) correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (c) 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	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

## Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.51	-52.44	-48.33	0.14	Pass

-- End of measurement results--

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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	-0.22	-0.20	-1.70	1.30	0.23	Pass
1000	0.12	0.00	-1.00	1.00	0.23	Pass
8000	-3.06	-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	40.69
-- End of measurement results--	

Calibration Certificate

Certificate Number 2022002971

Customer:

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

Model Number	LxT2	Procedure Number	D0001.8378
Serial Number	0006692	Technician	Jacob Cannon
Test Results	Pass	Calibration Date	9 Mar 2022
Initial Condition	As Manufactured	Temperature	23.91 °C ± 0.25 °C
Description	SoundTrack LxT Class 2	Humidity	50.6 %RH ± 2.0 %RH
	Class 2 Sound Level Meter	Static Pressure	85.35 kPa ± 0.13 kPa
	Firmware Revision: 2.404		

**Evaluation Method**  
Tested electrically using Larson Davis PRMLXT2C S/N 071561 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:

Model Number	IEC 60651:2001 Type 2	ANSI S1.4-2014 Class 2
Serial Number	IEC 60804:2000 Type 2	ANSI S1.4 (R2006) Type 2
Test Results	IEC 61252:2002	ANSI S1.25 (R2007)
Initial Condition	IEC 61672:2013 Class 2	ANSI S1.43 (R2007) Type 2
Description	IEC 61260:2001 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.

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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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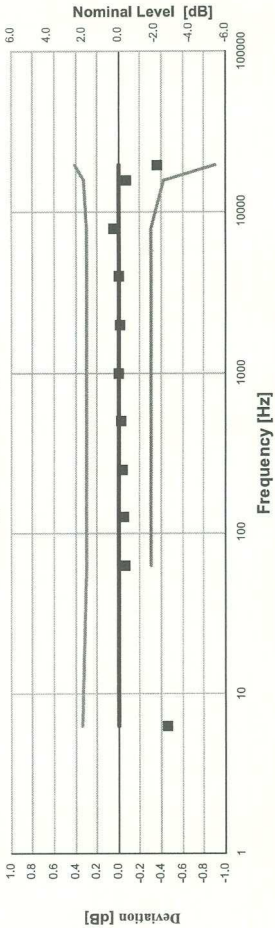
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Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-02-04	2022-08-04	006767
SRS DS360 Ultra Low Distortion Generator	2021-07-22	2022-07-22	007174

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 (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
6.31	-0.45	-0.45	-1.11	0.33	0.15	Pass
63.10	-0.06	-0.06	-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	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.01	-0.01	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.05	0.05	-0.30	0.30	0.15	Pass
15,848.93	-0.08	-0.08	-0.42	0.32	0.15	Pass
19,952.62	-0.36	-0.36	-0.91	0.41	0.15	Pass

-- End of measurement results--

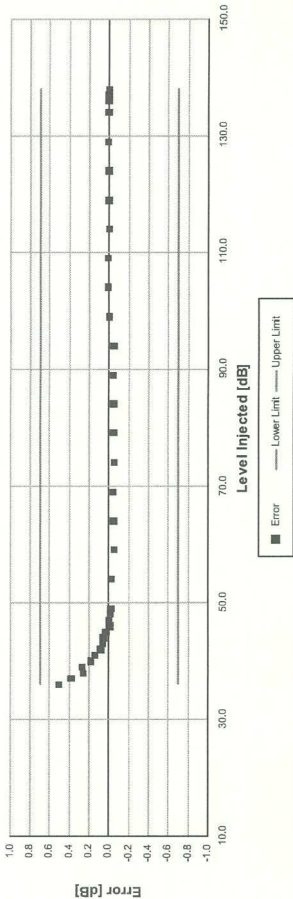


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A-weighted Broadband Log Linearity: 8,000.00 Hz



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 60904:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 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	0.26	-0.70	0.70	0.16	Pass
39.00	0.27	-0.70	0.70	0.16	Pass
40.00	0.18	-0.70	0.70	0.16	Pass
41.00	0.15	-0.70	0.70	0.16	Pass
42.00	0.08	-0.70	0.70	0.16	Pass
43.00	0.06	-0.70	0.70	0.16	Pass
44.00	0.05	-0.70	0.70	0.16	Pass
45.00	0.03	-0.70	0.70	0.16	Pass
46.00	0.00	-0.70	0.70	0.16	Pass
47.00	0.00	-0.70	0.70	0.16	Pass
48.00	-0.01	-0.70	0.70	0.16	Pass
49.00	-0.02	-0.70	0.70	0.16	Pass
50.00	-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	-0.05	-0.70	0.70	0.16	Pass
89.00	-0.04	-0.70	0.70	0.16	Pass
94.00	-0.05	-0.70	0.70	0.16	Pass
99.00	0.00	-0.70	0.70	0.15	Pass
104.00	0.01	-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	0.00	-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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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	135.03	133.55	135.55	0.15	Pass
		Positive Pulse	135.12	133.64	135.64	0.15	Pass
	30	Negative Pulse	133.78	135.55	135.55	0.15	Pass
		Positive Pulse	133.90	133.64	135.64	0.15	Pass
-- 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]	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	-0.15	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.16 ±	Pass
115.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
105.95	3	-0.12	± 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

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]	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	-0.20	± 1.00	0.15 ±	Pass
	5	-0.19	± 1.00	0.15 ±	Pass
115.95	3	-0.21	± 1.00	0.15 ±	Pass
	5	-0.18	± 1.00	0.15 ±	Pass
105.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.17	± 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	93.94	93.89	94.09	0.15	Pass
0 dB Gain, Linearity	40.30	39.39	40.79	0.16	Pass
OBA Low Range	93.99	93.89	94.09	0.15	Pass
OBA Normal Range	93.99	93.20	94.80	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	26.87	36.00	Pass
C-weight Noise Floor	26.80	35.00	Pass
Z-weight Noise Floor	32.77	39.00	Pass

-- End of measurement results--

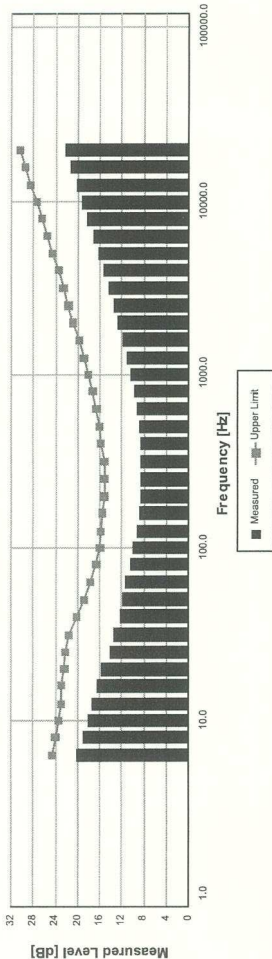
Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.67	134.15	135.75	0.15	Pass
THD	-67.46		-58.00	0.01 ‡	Pass
THD+N	-62.99		-58.00	0.01 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SUM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper Limit [dB]	Result
6.30	20.21	24.60	Pass
8.00	19.11	24.00	Pass
10.00	18.05	23.50	Pass
12.50	17.39	23.00	Pass
16.00	16.36	22.90	Pass
20.00	15.76	22.40	Pass
25.00	14.17	22.30	Pass
31.50	13.44	21.50	Pass
40.00	12.40	20.20	Pass
50.00	11.80	18.80	Pass
63.00	11.26	17.60	Pass
80.00	10.46	16.60	Pass
100.00	10.00	15.90	Pass
125.00	9.22	15.70	Pass
160.00	8.88	15.50	Pass
200.00	8.61	15.20	Pass
250.00	8.49	15.20	Pass
315.00	8.48	15.20	Pass
400.00	8.54	15.70	Pass
500.00	8.83	16.00	Pass
630.00	9.25	16.60	Pass
800.00	9.78	17.30	Pass
1,000.00	10.35	18.10	Pass
1,250.00	11.10	18.90	Pass
1,600.00	11.86	19.80	Pass
2,000.00	12.67	20.80	Pass
2,500.00	13.54	21.70	Pass
3,150.00	14.41	22.60	Pass
4,000.00	15.39	23.50	Pass
5,000.00	16.36	24.50	Pass
6,300.00	17.29	25.50	Pass
8,000.00	18.25	26.50	Pass
10,000.00	19.28	27.40	Pass
12,500.00	20.24	28.50	Pass
16,000.00	21.24	29.50	Pass
20,000.00	22.22	30.40	Pass

-- End of measurement results--

-- End of Report--

Signatory: *Jacob Cannon*

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARNY ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23MM331  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** AB204-S  
**Serial No. :** 1128312528  
**ID No. :** UAE.AIR.019/2550

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

**Location :** Balance Room 2

**Received order :** 07 April 2023  
**Calibration Date :** 07 April 2023  
**Ambient Temperature :** 15 °C to 40 °C  
**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Suwit Imjai

**Approved by :**   
Approved Signatory

( ) Ponthippa Tameyakul  
( / ) Malee Butkruea

**Issue Date :** 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-0015OC-1  
**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-QB01 according to direct measurement method against standard weight.

### Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0010-22	20 Jan 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This result of calibration was made on requested at the point specified by customer.  
4. This certificate is not certified for any commercial transaction.  
5. This certification is traceable to the International System of Unit.

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

**Range capacity :** 0 g to 220 g **Resolution** 0.0001 g

### Before Adjustment :

Applied Weight ( g )	Balance Reading ( g )	Correction ( g )	Measurement Uncertainty ( ± mg )	Coverage Factor ( k )
100	99.9999	+0.0001	0.19	2.03
200	200.0001	-0.0001	0.29	2.00

### After Adjustment :

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

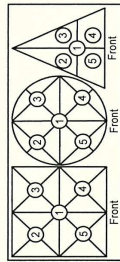
Applied Weight ( g )	Standard Deviation of Reading ( g )
100	0.00007
200	0.00007

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Equipment : Electronic Balance  
Condition As-Received : Used Item  
Reference : 2304-00150C-1  
Result of calibration

Cert.No.: 23MM331  
Page: 3 of 3



## 2. Effect of off center loading

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

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
-0.0001	-0.0002	+0.0004	-0.0001	-0.0006	0.0005

## 3. Departure from nominal value

Applied Weight (g)	Balance		Correction (g)	Measurement Uncertainty ( $\pm$ mg)	Coverage Factor (k)
	Reading (g)				
Unload	0.0000		0.0000	0.15	2.13
0.1	0.0999		+0.0001	0.15	2.13
1	0.9999		+0.0001	0.15	2.13
5	4.9999		+0.0001	0.15	2.13
10	9.9999		+0.0001	0.15	2.11
20	20.0000		0.0000	0.15	2.11
50	50.0000		0.0000	0.16	2.06
70	69.9999		+0.0001	0.18	2.04
100	99.9999		+0.0001	0.19	2.03
150	150.0003		-0.0003	0.29	2.00
200	200.0005		-0.0005	0.29	2.00

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

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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23MM332  
Page.: 1 of 3

## Certificate of Calibration


**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** AB204-S /FACT  
**Serial No. :** B108115858  
**ID No. :** UAE.AIR.016/2555

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

**Location :** Balance Room 2

**Received order :** 07 April 2023  
**Calibration Date :** 07 April 2023  
**Ambient Temperature :** 15 °C to 40 °C  
**Relative Humidity :** 30 % to 90 %

**Calibrated by :** Suwit Imjai

**Approved by :**   
Approved Signatory

( ) Ponthippa Tameyakul  
( / ) Malee Butkruea

**Issue Date :** 10 April 2023

The Uncertainties are for a confidence probability of approximately 95 %

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**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-0015OC-2  
**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-QB01 according to direct measurement method against standard weight.

### Condition of this result of calibration

1. Reference standard instruments:-

- | Instruments                 | Model | Serial No. | ID No.  | Test report No. | Due date    |
|-----------------------------|-------|------------|---------|-----------------|-------------|
| 1) Standard Weight Set (E2) | 15884 | 24053      | 70RC007 | MM-0010-22      | 20 Jan 2024 |
2. This certificate is valid only to the item calibrated on date and place of calibration.  
3. This result of calibration was made on requested at the point specified by customer.  
4. This certificate is not certified for any commercial transaction.  
5. This certification is traceable to the International System of Unit.

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

**Range capacity :** 0 g to 220 g **Resolution** 0.0001 g

**Before Adjustment :**

Applied Weight ( g )	Balance Reading ( g )	Correction ( g )	Measurement Uncertainty ( ± mg )	Coverage Factor ( k )
100	100.0002	-0.0002	0.21	2.06
200	200.0003	-0.0003	0.29	2.00

**After Adjustment :**

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

Applied Weight ( g )	Standard Deviation of Reading ( g )
100	0.00009
200	0.00007

Cert.No.: 23MM332  
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**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-00150C-2  
**Result of calibration**

**2. Effect of off center loading**

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

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002	0.0005

**3. Departure from nominal value**

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty ( $\pm$ mg)	Coverage Factor (k)
Unload	0.0000	0.0000	0.18	2.17
0.1	0.0999	+0.0001	0.18	2.17
1	0.9998	+0.0002	0.18	2.17
5	5.0000	0.0000	0.18	2.17
10	10.0000	0.0000	0.18	2.17
20	20.0000	0.0000	0.18	2.15
50	50.0001	-0.0001	0.19	2.11
70	70.0001	-0.0001	0.20	2.07
100	100.0002	-0.0002	0.21	2.06
150	150.0004	-0.0004	0.29	2.00
200	200.0005	-0.0005	0.29	2.00

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

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