

ภาคผนวก ง

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เอกสารสอบเทียบเครื่องมือตรวจวัด

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

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Ambient</b>									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Thermo Scientific	G25A 158M	Tisch Environmental, Inc.	05072022	5 Jul 22	4 Jul 24	-
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)	22P914	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)	22H1583	27 Jul 22	26 Jul 23	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1182920007	UAE Consultant Co., Ltd.	21062022	21 Jun 22	20 Jun 23	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1182920009	UAE Consultant Co., Ltd.	17102022	17 Oct 22	16 Oct 23	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1191503036	UAE Consultant Co., Ltd.	23062022	23 Jun 22	22 Jun 23	-
8	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1191503038	UAE Consultant Co., Ltd.	19102022	19 Oct 22	18 Oct 23	-
9	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-0607415779	UAE Consultant Co., Ltd.	18102022	18 Oct 22	17 Oct 23	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-62236-334	UAE Consultant Co., Ltd.	17102022	17 Oct 22	16 Oct 23	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920013	UAE Consultant Co., Ltd.	20102022	20 Oct 22	19 Oct 23	-

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

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Ambient</b>									
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1180540066	UAE Consultant Co.,Ltd.	25102022	25 Oct 22	24 Oct 23	-
14	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D1	21 Jun 21	21 Jun 24	-
15	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 21020224	Thai Meteorological Department	414/23	12 Jul 22	11 Jul 23	-
16	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35A 73249	Innovative Instrument Co.,Ltd.	22-ACT-406	1 Jul 22	30 Jun 23	-
17	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0005398	Innovative Instrument Co.,Ltd.	22-ACT-035	21 Jan 22	20 Jan 24	-
18	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0005400	Innovative Instrument Co.,Ltd.	22-ACT-036	21 Jan 22	20 Jan 24	-
19	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0005402	Innovative Instrument Co.,Ltd.	22-ACT-103	11 Feb 22	10 Feb 24	-
20	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0005405	Innovative Instrument Co.,Ltd.	22-ACT-101	11 Feb 22	10 Feb 24	-
21	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0006614	Innovative Instrument Co.,Ltd.	22-ACT-104	11 Feb 22	10 Feb 24	-
22	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0006615	Innovative Instrument Co.,Ltd.	22-ACT-102	11 Feb 22	10 Feb 24	-
23	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0006616	Innovative Instrument Co.,Ltd.	22-ACT-113	15 Feb 22	14 Feb 24	-
24	Sound Level Meter	$L_{Aeq} 24 \text{ hr}$ $L_{Aeq} 1 \text{ hr}$ $L_{Amax}$ $L_{A90}$	Larson Davis	LxT2 0006617	Innovative Instrument Co.,Ltd.	22-ACT-100	11 Feb 22	10 Feb 24	-

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA0D0081	Technology Promotion Association (Thailand-Japan)	23CH6	5 Jan 23	4 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE0G0017	Technology Promotion Association (Thailand-Japan)	23TW9	16 Jan 23	15 Jan 24	-

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

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Workplace</b>									
1	Thermal Environment Monitor	Heat Meter	Quest Technologies, Inc	QuesTemp 34 OTE1010003	Innovative Instrument Co.,Ltd.	22-TPM-304	26 Jul 22	25 Jul 23	-
2	Thermal Environment Monitor	Heat Meter	Quest Technologies, Inc	QuesTemp 34 TEK120020	Innovative Instrument Co.,Ltd.	22-TPM-311	27 Jul 22	26 Jul 23	-
3	Air Flow Meter	Calibrate personal pump	TSI,Inc	4146 41461813030	Miracle International Technology Co.,Ltd.	L202209270-001	5 Oct 22	4 Oct 23	-
4	Aneroid Barometer	Total Dust	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2724	22 Jul 22	21 Jul 23	-
5	Digital Thermo - Hygrometer	Total Dust	Testo, Germany	608-H1 34837413	Technology Promotion Association (Thailand-Japan)	22H1987	27 Sep 22	26 Sep 23	-
6	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	SvanteK	SV36 107224	Innovative Instrument Co.,Ltd.	22-ACT-526	19 Aug 22	18 Aug 23	-
7	Sound Level Meter	$L_{Aeq\ 8\ hrs}$ $L_{Amax}$	Rion, Japan	NL-42 01010779	Sithiporn Associates Co., Ltd.	ACL22085	22 Apr 22	21 Apr 23	-
8	Sound Level Meter	$L_{Aeq\ 8\ hrs}$ $L_{Amax}$	Rion, Japan	NL-42 01010781	Sithiporn Associates Co., Ltd.	ACL22087	22 Apr 22	21 Apr 23	-

## Certificate of Calibration

### Customer

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

Certificate No : 22-ACT-035

Request No : Req-2022-0094

### Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : LxT2  
Serial Number : 0005398  
ID : UAE.EFM.0352564  
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 : 14 January 2022  
Calibrated Date : 21 January 2022

Instrument Status : Used

Calibration Procedure : Le-Noise 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 : 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 %.

Approved By : 

Mr. Noppadon Luangart

Calibration Engineer

Issue Date : 21 January 2022

Approved By : 

Mr. Pasit Mathavorn

Calibration Engineer Supervisor

Issue Date : 21 January 2022

Certificate No : 22-ACT-035

Request No : Req-2022-0094

### 1. Indication at the calibration check frequency

UUC Setting	Nominal Level (dB)	Before Adjust		Adjust		Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)	
FAST / A / 37-139						
Calibrator Setting						
1000 Hz 114.00 dB	113.85	114.0	+0.15	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		
UUC Weighting	(dB)	(± dB)
A	28.1	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	27.9	0.10
C	27.3	0.10
Z	31.9	0.10

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

UUC Setting	Deviation From various Frequency Weighting Response curve			Acceptance Limit (± dB)
	A	C	Z	
FAST / 37-139	(dB)	(dB)	(dB)	(± dB)
STD Setting				
125 Hz	0.0	0.0	0.0	2.0
1000 Hz	0.0	0.0	0.0	1.0
4000 Hz	0.4	0.3	0.3	3.0
8000 Hz	-0.1	-0.2	-0.1	5.0

Certificate No : 22-ACT-035  
Request No : Req-2022-0094

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ 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 REF (dB)	Deviation		UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
		UUC (dB)	ERR (dB)		
FAST / A / 37-139					
STD dB					
139.00	139	139.8	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	69.0	0.0		1.1
64.00	64	63.9	-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		0.8
44.00	44	44.1	0.1		1.1
39.00	39	39.3	0.3		1.1
38.00	38	38.3	0.3		1.1
37.00	37	37.5	0.5		1.1

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the laboratory. Issue date: 01/07/19

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Certificate No : 22-ACT-035  
Request No : Req-2022-0094

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

UUC Setting	Deviation from various Frequency Weighting Response curve				UNCERTAINTY ( $\pm$ dB)	Acceptance Limit ( $\pm$ dB)
	A (dB)	C (dB)	Z (dB)			
FAST / 37-139						
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	0.0	-0.1			1.5
500 Hz	-0.1	0.0	-0.1			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
16000 Hz	-0.1	-0.1	-0.1			+5, -INF.

6. Frequency and time weightings at 1kHz

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

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

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the laboratory. Issue date: 01/07/19

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Certificate No : 22-ACT-035  
Request No : Req-2022-0094

9. Level linearity including the level range control

UUC Setting	STD REF	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)		
FAST / A	43.2	43.4	0.2	0.3	1.1
	114	114.0	0.0		1.1

10. Tone burst response

UUC Setting	STD Toneburst (ms)	Anticipated Ref (dB)	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
			UUC (dB)	ERR (dB)		
UUC Time Response	200	135.0	135.0	0.0	0.3	1
	2	118.0	117.9	-0.1		+1.0, -2.5
	0.25	109.0	108.7	-0.3		+1.5, -5.0
	200	128.6	128.5	-0.1		1
Slow	2	109.0	108.9	-0.1	0.3	+1.0, -5.0
	200	129.0	129.0	0.0		1
SEL	2	109.0	109.1	+0.1	0.3	+1.0, -2.5
	0.25	100.0	99.9	-0.1		+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated REF	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)		
FAST / C / 95-142	137.4	136.8	-0.60	0.2	3.0
Complete cycle	136.4	136.1	-0.30		2.0
Positive half cycle	136.4	136.1	-0.30		2.0

Certificate No : 22-ACT-035  
Request No : Req-2022-0094

12. Overload indication

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 37-139	UUC (dB)	0.2	1.5
STD Setting	142.3		
Positive one-half cycle	142.0		
Negative one-half cycle	142.0		
Deviated	0.3	0.2	1.5

13. High Level Stability

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

End of Certificate



## Certificate of Calibration

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

**Certificate No** : 22-ACT-406  
**Request No** : Req-2022-1080

**Unit Under Calibration Details**  
**Measurement item** : Acoustic Calibrator  
**Manufacturer** : SVANTEK  
**Model** : SV 35A  
**Serial Number** : 73249  
**ID** : UAE.EFM.105/2561

**Class** : 1  
**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** : 15 June 2022  
**Calibration Date** : 1 July 2022  
**Location of Calibration** : LAB 1 Acoustic

**Calibration Procedure** : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 2023
THD Multimeter	2015	1047765	NIMT	2 February 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 %.

**Calibrated By** :   
Mr. Noppadon Luangut  
Service Calibration Engineer  
**Approved By** :   
Mr. Pacit Mathavom  
Calibration Engineer Supervisor  
**Issue Date** : 1 July 2022

**Certificate No** : 22-ACT-406

**Request No** : Req-2022-1080

**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	93.82	-0.18	-	-	0.11	0.25
	114 dB / 1000 Hz	113.81	-0.19	-	-	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 (%)	Error (%)	Measured (%)	Error (%)		
94 dB / 1000 Hz	0.17	-	-	-	0.40	2.5
114 dB / 1000 Hz	0.04	-	-	-	0.40	2.5

### Note :

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

**End of Calibration**

## Certificate of Calibration

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

**Certificate No** : 22-ACT-526  
**Request No** : Req-2022-1562

**CO.LTD.**

### Unit Under Calibration Details

**Measurement item** : Acoustic Calibrator  
**Manufacturer** : SVANTEK  
**Model** : SV 36  
**Serial Number** : 107224  
**ID** : UAE.EFM.171/2564  
**Class** : 1  
**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** : 11 August 2022  
**Calibration Date** : 19 August 2022  
**Location of Calibration** : LAB 1 Acoustic

**Calibration Procedure** : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 2023
THD Multimeter	2015	1047765	NIMT	2 February 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 %.

**Calibrated By** : **Mr. Noppadon Luangart**  
Service Calibration Engineer  
**Approved By** : **Mr. Pacit Muthavorn**  
Calibration Engineer Supervisor  
**Issue Date** : 19 August 2022

**Certificate No** : 22-ACT-526

**Request No** : Req-2022-1562

**Calibration Results** : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Acceptance limit Class 1 ( ± dB)
	Measured	Error	Measured	Error	
94 dB / 1000 Hz	94.05	0.05	-	-	0.25
114 dB / 1000 Hz	114.07	0.07	-	-	0.25

### Frequency of Sound pressure level

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

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Acceptance limit Class 1 ( ± %)
	Measured (%)	Error (%)	Measured (%)	Error (%)	
94 dB / 1000 Hz	0.24	-	-	-	2.5
114 dB / 1000 Hz	0.31	-	-	-	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



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



## Certificate of Calibration

Certificate No. : 22H1987

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Equipment: Digital Thermo-Hygrometer

Manufacturer:

Model : 608-H1

Serial No.: 34837413

ID No.: UAE.ANV.134/2550

Condition As-Received: Used Item

Received Date: 21 September 2022

Calibration Date: 23 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,

Phra Khanong, Bangkok 10260

Procedure used:

Calibration were 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	2380195	20703	02 Aug 2023
2) Standard Humidity/Temperature Meier	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 Waewanjua

[ / ] Ponthippa Taneyakul

[ / ] Viporn Tantiyawutti

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B 0298128



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Result of Calibration:-

Function:

Without Adjustment

Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	43.7	3.6	1.3
25.0	50.1	53.6	3.5	1.6
25.0	60.0	63.4	3.4	1.6
25.0	70.2	73.4	3.2	1.6

Result of Calibration:-

Function:

Without Adjustment

Temperature measurement.

Temperature (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
15.02	15.1	15.1	0.08	0.42
20.03	20.1	20.1	0.07	0.42
25.02	25.1	25.1	0.08	0.42
30.03	30.0	30.0	-0.03	0.42
40.03	39.8	39.8	-0.23	0.42

UUC\* : Unit Under Calibration

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

-o0o-

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a 1128759



## Certificate of Calibration

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

**Certificate No :** 22-TPM-304  
**Request No :** Req-2022-1245  
**Page :** 1/2

### Unit Under Calibration Details

**Calibration Parameter :** Temperature  
**Instrument Name :** Thermal Environment Monitor  
**Manufacturer :** TSI QUEST  
**Model :** QT-34  
**Serial Number :** OTE1010003  
**Resolution :** 0.1 °C  
**ID Number :** UAE.EMA2.090/2533

**Range Calibration :** 20 °C to 60 °C  
**Type of Sensor :** RTD  
**Sensor Diameter (mm) :** 4.5  
**Calibration Position (mm) :** 67.5  
**Instrument Status :** Used

### 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.

**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 Robbom Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

### Note

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

**Approved By :**   
Mr. Paet Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 26 July 2022



### Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 22-TPM-304

Request No : Req-2022-1245

Page : 2/2

### Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (k=2)
WET	20.003	19.9	+0.1	0.14
	25.005	24.9	+0.1	0.14
	30.004	29.9	+0.1	0.14
	35.004	34.9	+0.1	0.14
	40.003	39.9	+0.1	0.14
	45.005	44.9	+0.1	0.14
	50.004	50.1	-0.1	0.14
DRY	60.007	60.1	-0.1	0.14
	20.004	20.0	0.0	0.14
	25.004	25.0	0.0	0.14
	30.006	30.0	0.0	0.14
	35.007	35.0	0.0	0.14
	40.007	39.9	+0.1	0.14
	45.004	44.9	+0.1	0.14
GLOBE	50.006	50.0	0.0	0.14
	60.002	60.0	0.0	0.14
	20.005	19.9	+0.1	0.14
	25.004	24.9	+0.1	0.14
	30.003	29.9	+0.1	0.14
	35.005	34.9	+0.1	0.14
	40.006	39.9	+0.1	0.14
	45.007	44.9	+0.1	0.14
	50.008	50.1	-0.1	0.14
	60.006	60.1	-0.1	0.14

End of Certificate

**Calibrated By :**   
Mr. Stitichok Jirapukdossakun

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.

Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



NSC-TS1-TS 17025  
CALIBRATION 0394

Cert. No. : ACL22087

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01010781 / 194536 / 14659  
**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 :**

*T. Petchurai*  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22087

Job No. : YC65AC0045

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 (ITISTR).

QF-TS12-04-04-020664

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*T. Petchurai*

## Continuation of Calibration Certificate

Cert. No. : ACL22087  
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

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T. Petcha-

## Continuation of Calibration Certificate

Cert. No. : ACL22087  
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)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	12.5
C - weight	18.9
Flat	24.4

## 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	0.0	0.0	± 1.5
1000	-0.1	-0.1	± 1.0
8000	0.1	0.1	±5.0

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Continuation of Calibration Certificate

Cert. No. : ACL22087  
Job No. : VC65AC0045  
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 Acceptance Limits
63	-0.1	-0.1	±2.0
125	0.0	0.0	±1.5
250	0.0	0.0	±1.5
500	0.0	0.0	±1.5
1000	0.0	0.0	±1.0
2000	0.0	0.1	±2.0
4000	0.0	0.0	±3.0
8000	0.0	0.1	±5.0

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. : ACL22087  
Job No. : VC65AC0045  
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	84.0	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	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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T. Rth.

Continuation of Calibration Certificate

Cert. No. : ACL22087  
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	134.1	0.1	±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, 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	133.0	0.0	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL22087  
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	89.5	±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



# Certificate of Calibration

## Calibration Certification Information

Cal. Date: July 5, 2022      Rootsmeter S/N: 438320      Ta: 297 °K  
Operator: Jim Tisch      Pa: 750.1 mm Hg  
Calibration Model #: G25A      Calibrator S/N: 158M

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3240	3.2	2.00
2	3	4	1	0.9480	6.4	4.00
3	5	6	1	0.8480	7.9	5.00
4	7	8	1	0.8060	8.7	5.50
5	9	10	1	0.6670	12.7	8.00

## Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9860	0.7447	1.4073	0.9957	0.7521	0.8899
0.9818	1.0357	1.9902	0.9915	1.0459	1.2585
0.9798	1.1554	2.2251	0.9895	1.1668	1.4071
0.9788	1.2143	2.3337	0.9884	1.2263	1.4757
0.9735	1.4595	2.8146	0.9831	1.4739	1.7798
<b>QSTD</b>	m=	1.96745	<b>QA</b>	m=	1.23199
	b=	-0.05315		b=	-0.03361
	r=	0.99995		r=	0.99995

## Calculations

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

## Standard Conditions

Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: rootsmeter 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



MIRACLE INTERNATIONAL TECHNOLOGY CO., LTD  
214 Bangwaek Rd. Bangpai Bangkok 10160  
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



## CALIBRATION CERTIFICATE

Certificate No. : L202209270-001  
Date Issued : 31-Oct-22

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

**Equipment** : Primary Air Flow Meter

**Manufacturer** : TSI

**Model** : 4146 F

**Serial No.** : 4146 1813 030

**ID No./Tag No.** : UAE.EFM.102/2561

**Date Received** : 29-Sep-22

**Date Calibrated** : 05-Oct-22

**Calibrated by** : Mr. Jame Khaothong

**Calibration Method or Calibration Procedure Used**

In-house method : CP-26 by comparison against Bell Prover.

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

### Result of Calibration

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

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Approved by:

Sasayuth T.  
(Mr. Sarayuth Tochua)



Page 1 of 3

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Certificate No. : L202209270-001

**Environment** : Ambient temperature :  $(23 \pm 2)^\circ\text{C}$

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

**Capacity Range** : 20 l/min

**Calibration Media** : Air

**Type** : Mass Flowmeter

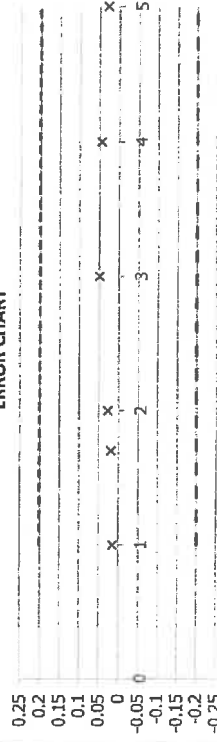
**UUC Reference Condition** : Pressure 101.325 kPa(abs) ,  $21.1^\circ\text{C}$  , Air

### Measurement Gas Flow rate function

Temperature ( $^\circ\text{C}$ )	Pressure (kPa)	UUC (l/min)	STD (l/min)	Error (l/min)	Uncertainty ( $\pm$ l/min)
22.93	101.69	1.000	0.9852	0.0148	0.0035
23.20	101.73	1.700	1.6810	0.0190	0.0059
23.52	101.74	2.000	1.9732	0.0268	0.0070
23.10	101.38	3.000	2.9512	0.0488	0.0077
23.11	101.45	4.000	3.956	0.044	0.011
23.11	101.57	5.000	4.972	0.028	0.031

Error = Unit Under Calibration - Standard

### ERROR CHART



x Error (l/min) --- Upper Limit (l/min) --- Lower Limit (l/min)

### FLOWRATE (l/min)

Note: Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{Meas} = Q_{Ref} \times \frac{P_{Ref}}{P_{Meas}} \times \frac{T_{Meas}}{T_{Ref}}$$

where

Q = Flow rate

P = Absolute pressure

T = Absolute temperature

M = Gas molecular weight, Mstandard (Air) = 28.9646431 g/mol

Subscript "Meas" = Measurement condition

Subscript "Standard" = Standard condition

Page 2 of 3

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Certificate No. : L202209270-001

Condition As-Received : Used Item

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

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Calibration Certificate No. AD2204-030-0002 for Bell Prover Volume (60L) Serial No. 9511HC028626, Due 11-Apr-24

MIT Calibration Certificate No. L2022-08263-001 for Bell Prover Timer Serial No. 9511HC028626, Due 09-Aug-23

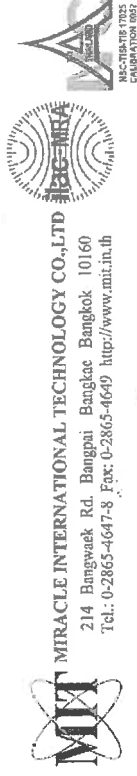
MIT Calibration Certificate No. AD2205-300-0001 for Temperature Transmitter with probe Serial No. MIT-STD-122, Due 04-Jun-23

MIT Calibration Certificate No. AD2205-300-0002 for Pressure Transmitter with indicator Serial No. MIT-STD-123, Due 04-Jun-23

End of Certificate

Page 3 of 3

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



## CALIBRATION CERTIFICATE

Certificate No. : L202211085-002  
Date Issued : 18-Nov-22

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

Equipment : Primary Air Flow Meter

Manufacturer : TSI  
Model : 4146 F  
Serial No. : 4146 1813 030  
ID No./Tag No. : UAE.EFM.102/2561  
Date Received : 10-Nov-22  
Date Calibrated : 17-Nov-22

Calibrated by : Mr. Jame Khachong

Calibration Method or Calibration Procedure Used

In-house method : CP-26 by comparison against Bell Prover.  
In-house method : CP-44 by comparison against Piston Prover.

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

Result of Calibration

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

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

Approved by: *Sarayuth T.*  
( Mr. Sarayuth Tochua )



Page 1 of 3

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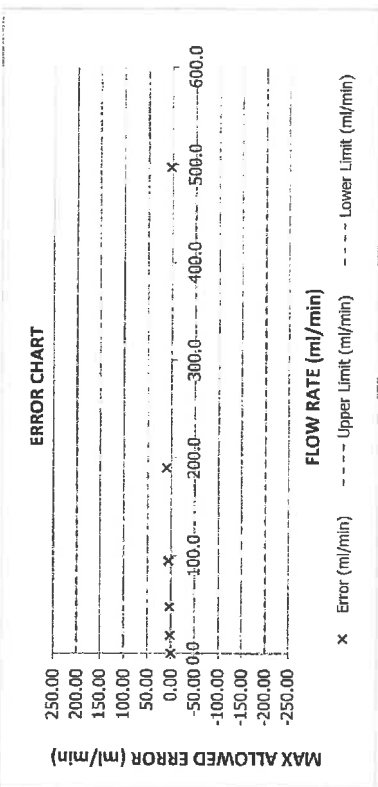
Certificate No. : L202211085-002

Environment : Ambient temperature : ( 23 ±2 ) °C  
Relative humidity : ( 50 ±15 ) % RH  
Capacity Range : 20000 ml/min  
Calibration Media : Air  
UUC Reference Condition : Pressure 101.325 kPa @ 21.1 °C, Air

Temperature (°C)	Pressure (kPa)	Flow Rate Reading UUC Reading	Flow Rate Reading STD Reading	Error (ml/min)	Uncertainty (ml/min)
23.304	100.62	0.0	0.000 *	0.000	1.1
23.267	101.12	20.00	18.441	1.559	1.1
23.252	101.11	50.0	47.617	2.383	0.59
23.156	101.10	100.0	94.807	5.193	1.1
22.889	101.17	200.0	189.987	10.013	1.2
23.20	101.13	500.0	497.300	2.700	2.6

Error = Unit Under Calibration - Standard

Marked \* are not included in the TISI accreditation schedule for our laboratory.



Certificate No. : L202211085-002

Note : The actual flow rate is determined by the equation :

$$Q_{Meas} = Q_{Ref} \times \frac{P_{Ref}}{P_{Meas}} \times \frac{T_{Meas}}{T_{Ref}}$$

: Q = Flow rate  
: P = Absolute pressure  
: T = Absolute temperature  
: Subscript "Meas" = Measurement condition  
: Subscript "Ref" = Reference condition

Condition As-Received : Used Item  
The measurement results and statements of conformity with specification only relate to the item calibrated.  
Measurement Standards Used :

MIT Calibration Certificate No. AD2205-312-0001 for Piston Prover Volume Serial No. 85, Due 20-May-24  
MIT Calibration Certificate No. AD2202-261-0002 for Piston Prover Timer Serial No. 122199, Due 03-Mar-24  
MIT Calibration Certificate No. AD2202-261-0003 for Absolute Pressure (Piston Prover) Serial No. 220368, Due 22-Feb-24

MIT Calibration Certificate No. AD2202-261-0004 for Temperature Indicator with Sensor (Piston Prover) Serial No. MIT-STD-258, Due 02-Mar-24  
MIT Calibration Certificate No. AD2204-030-0002 for Bell Prover Volume (60L) Serial No. 9511HC028626, Due 11-Apr-24

MIT Calibration Certificate No. L2022-08263-001 for Bell Prover Timer Serial No. 9511HC028626, Due 09-Aug-23  
MIT Calibration Certificate No. AD2205-300-0001 for Temperature Transmitter with probe Serial No. MIT-STD-122, Due 04-Jun-23

MIT Calibration Certificate No. AD2205-300-0002 for Pressure Transmitter with indicator Serial No. MIT-STD-123, Due 04-Jun-23

End of Certificate

# 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 April, 2021 Certification No. 206/21

Page : 1 of 7

Object : เครื่องมือวัดอุตุนิยมวิทยา

Manufacturer : LSI

Type : Data Logger E-LOG 305 wind speed and wind direction DNA 821  
Thermogrometers DMA875 Barometer DQA 801  
Mfg Code : Data Logger 21020224 wind speed and wind direction 20010221  
Thermogrometers 19100298 Barometer 20030067

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 1014.6 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

STANDARD THERMOMETER

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

STANDARD BAROMETER : Digital Barometer Vaisala Type P1B720 No. 0015

: Digital Barometer Vaisala Type PTE3-30 No. 64320061

Calibrated by : Watcharapol Subwat

Mr. Watcharapol Subwat

Mechanical Engineer

Signed : Mr. Pisoot Pimmut

Mr. Pisoot Pimmut

Mechanical Engineer



# THAI METEOROLOGICAL DEPARTMENT

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



## The Result of Calibration

Wind Speed And Wind Direction

Certification No. 206/21

12 April, 2021 Model DNA821 S/N 20010221 Page : 2 of 7

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacuum inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.1	-0.10
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.5	0.52
11.02	-	-	-	10.8	0.22
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

Wind Aloft Plotting Board.

US.DEPARTMENT OF COMMERCE WEATHER BUREAU

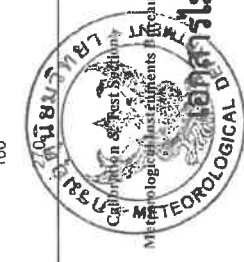
WIND DIRECTION	TESTED WIND DIRECTION	
	0	90
0	0	90
90	0	90
180	0	90
270	0	90

Calibrated by :

Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer





## The Result of Calibration

Barometer Model DQA801 s/n 20030067

Certification No. 206/21

12 April, 2021 Page : 3 of 7

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.77	1011.0	-0.23
1008.67	1008.9	-0.23
1010.49	1010.8	-0.31
1010.67	1011.0	-0.33
1010.78	1011.1	-0.32
1011.09	1011.5	-0.41
1011.21	1011.7	-0.49
1011.06	1011.5	-0.44
1010.80	1011.1	-0.30
1010.62	1011.0	-0.38
1010.45	1010.8	-0.35
1009.93	1010.3	-0.37
1009.78	1010.2	-0.42
1009.43	1009.8	-0.37
1009.29	1009.9	-0.61
1008.93	1009.4	-0.47
1008.66	1009.0	-0.34
1008.33	1008.7	-0.37
1008.15	1008.5	-0.35
1007.28	1007.6	-0.32

Average

Calibrated by : *Watharapol*

Mr. Watharapol Subwat  
Mechanical Engineer



เอกสารไม่ควบคุม



## The Result of Calibration

Barometer Model DQA801 s/n 20030067

Certification No. 206/21

12 April, 2021 Page : 4 of 7

Standard Barometer Pressure	Tested Barometer Pressure	Correction
758.14	758.3	-0.17
756.58	756.7	-0.17
757.93	758.2	-0.23
758.08	758.3	-0.25
758.15	758.4	-0.24
758.38	758.7	-0.31
758.47	758.8	-0.37
758.36	758.7	-0.33
758.16	758.4	-0.23
758.03	758.3	-0.29
757.90	758.2	-0.26
757.51	757.8	-0.28
757.40	757.7	-0.32
757.13	757.4	-0.28
757.03	757.5	-0.46
756.76	757.1	-0.35
756.56	756.8	-0.26
756.31	756.6	-0.28
756.17	756.4	-0.26
755.52	755.8	-0.24

Average

Calibrated by : *Watharapol*

Mr. Watharapol Subwat  
Mechanical Engineer



เอกสารไม่ควบคุม

# THAI METEOROLOGICAL DEPARTMENT



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

## The Result of Calibration

Thermogrometers Model DMA 875 s/n 19100298

Certification No. 206/21

12 April, 2021

Page : 5 of 7

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.24	45.31	-0.07
30.36	30.46	-0.10
15.12	15.19	-0.07

Calibrated by : *Watchapol*

Mr. Watchapol Subwat  
Mechanical Engineer



เอกสารไม่ควบคุม



# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Thermogrometers Model DMA 875 s/n 19100298

Certification No. 206/21

12 April, 2021

Page : 6 of 7

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
84.25	82.3	1.95
62.14	62.0	0.14
41.32	42.3	-0.98

Calibrated by : *Watchapol*

Mr. Watchapol Subwat  
Mechanical Engineer



เอกสารไม่ควบคุม



Date of Issue 12 April, 2021

Certification No.206/21

Page: 7 of 7

## ใบรับรอง

หนังสือฉบับนี้รับรองว่า เครื่องวัดฝน ยี่ห้อ LSI แบบ TIPPING BUCKET ขนาด 324 cm<sup>2</sup> Model DQA 230.1 Serial 20020189 ทำการสอบเทียบกับแก้วฝนแบบ แก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)



ลงชื่อ..... กิ่งกมล

(นายวัชรพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ

เอกสารไม่ควบคุม



### 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
Nitric Oxide (NO)	45.35
Methane (CH <sub>4</sub> )	-
Carbon Monoxide (CO)	1007
Cylinder No. :	CC159599
Expiration Date :	Jul 30, 2022

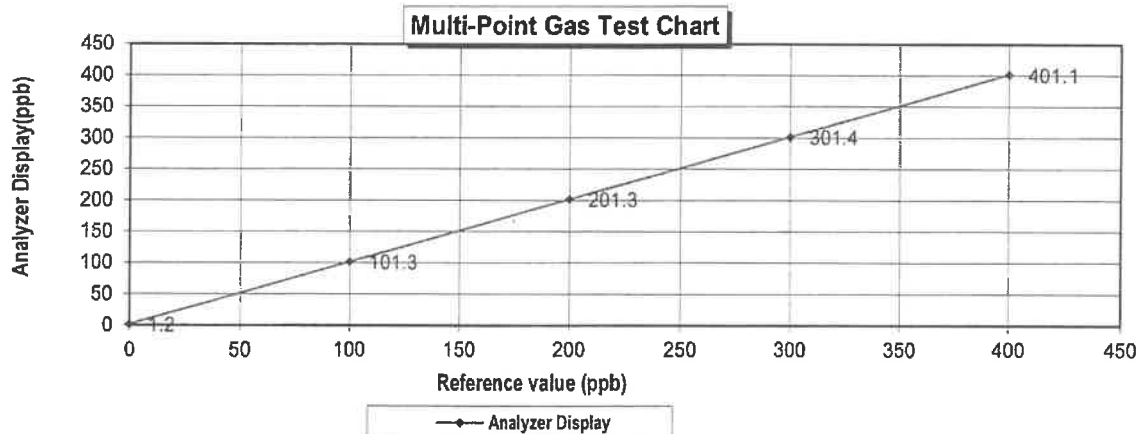
#### Dilutor Detail

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

#### Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	1.2	1.20	1.20	1.20
Level 2	20.00%	100.0	101.3	1.30	1.28	1.28
Level 3	40.00%	200.0	201.3	1.30	0.65	0.65
Level 4	60.00%	300.0	301.4	1.40	0.46	0.46
Level 5	80.00%	400.0	401.1	1.10	0.27	0.27
Remark : Measuring Range 500.0 ppb				Average Difference (%)		0.77

:Acceptable Limit  $\pm 5\%$



Calculate by

Sirichai Y.

21, 06, 65

Approve by

Ver n u

21, June, 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 23CH6  
Page: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Horiba  
Model : LAQUA-PH210  
Serial No. : HA0D0081  
ID No. : UAE.EFM.074/2564(EFM.pH.07/64)  
Condition As-Received: Used Item  
Received Date : 04 January 2023  
Calibration Date : 05 January 2023  
Reference : 2301-0060WSC-2  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260

Ambient Temperature :  $(25 \pm 2.5) ^\circ\text{C}$   
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 : Sathip Meangmai

Approved by :   
Approved Signatory

( / ) Malee Butkuea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 10 January 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.

เอกสารไม่ควบคุม



Cert.No.: 23CH6  
Page: 2 of 3

### Condition of this calibration result

1. Reference Standard Instrument : -  
Instrument  
1) Document Process Calibrator 54030049 130RC116 Cert. No. 22E2769 Due Date 24 Aug 2023  
2) Ref. Standard Thermometer 4982054 110RC044 2211306 27 Oct 2023  
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	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 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 ( $\pm\text{mV}$ )	Coverage factor k
			mV	pH		
pH Meter S/N.: HA0D0081	pH 4.00	177.48	177.4	4.01	0.058	2.00
	7.00	0.00	0.1	6.98	0.058	2.00
	10.00	-177.48	-177.4	10.01	0.058	2.00

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Cert.No.: 23CH6  
Page.: 3 of 3

#### Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor $k$
pH Electrode S/N.: 990C0039	4.008	4.01	138.5	0.0085	2.05
	6.987	6.98	-32.1	0.011	2.00
	6.987	7.00	-33.1	0.011	2.00
	10.008	10.03	-205.2	0.0096	2.00

#### Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652
- Serial No. : 990C0039
- Dimension of probe;
  - Length : 102 mm.
  - Diameter : 15.5 mm.
  - Immersion Depth : 85 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ( $\pm$ °C)	Coverage factor $k$
25.0	25.004	25.0	-0.004	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 %.

-o0o-

เอกสารไม่ควบคุม

### MULTI-POINT GAS TEST REPORT

**Test Date** : Oct 18, 2022

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

**Model :** 43C  
**Serial Number :** 43C-0607415779

#### Standard Gas Concentration

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

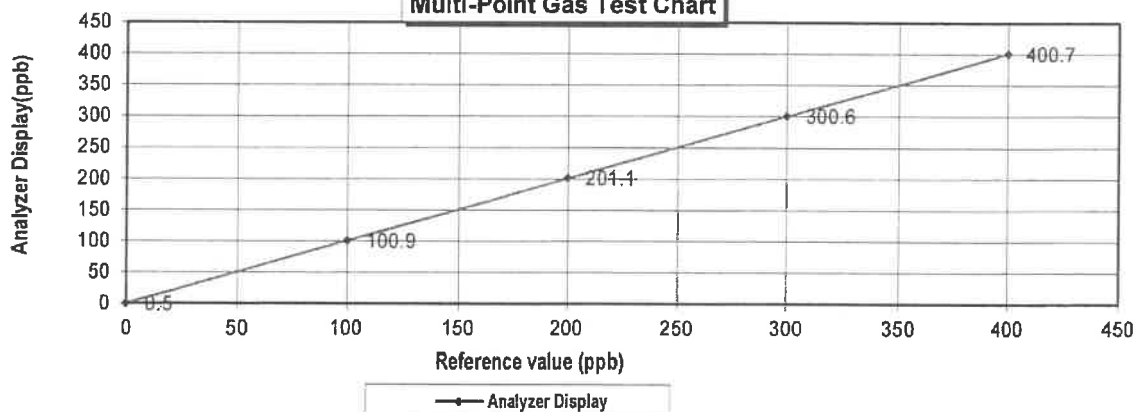
#### Dilutor Detail

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

#### Multi-point gas test data

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error ]
Level 1	Zero	0.0	0.5	0.50	0.50	0.50
Level 2	20.00%	100.0	100.9	0.90	0.89	0.89
Level 3	40.00%	200.0	201.1	1.10	0.55	0.55
Level 4	60.00%	300.0	300.6	0.60	0.20	0.20
Level 5	80.00%	400.0	400.7	0.70	0.17	0.17
Remark : Measuring Range 500.0 ppb			Average Difference (%)		0.46	

Multi-Point Gas Test Chart



Calculate by

*Girichai yamgan*  
18, 10, 65

Approve by

*[Signature]*  
18, Oct, 2022

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3  
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-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a 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	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 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	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 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 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES: PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



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

*[Signature]*

Approved for Release



CERT 3082.01

เอกสารแนบคุณ