

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Tisch Environmental, Inc.	TE-5025A 3383	Tisch Environmental, Inc.	5072019	5 Jul 19	4 Jul 20	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	20P576	3 Feb 20	2 Feb 21	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	20P665	10 Feb 20	9 Feb 21	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	20H404	6 Feb 20	5 Feb 21	-
6	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48C 48CCTL-65506-348	UAE Consultant Co., Ltd.	08052019	8 May 19	7 May 20	-
7	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48C 48C-71185-368	UAE Consultant Co., Ltd.	08052019	8 May 19	7 May 20	-
8	Standard Gases (Mixture)	Carbon Monoxide	Airgas	CC159599 2015PSIG	Airgas an Air Liquide company	160-401526192-1	30 Jul 19	30 Jul 22	-
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Environmental Instrument	42C 42C-78933-390	UAE Consultant Co., Ltd.	25042019	25 Apr 19	24 Apr 20	-
10	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Environmental Instrument	42C 42C-0508011074	UAE Consultant Co., Ltd.	25042019	25 Apr 19	24 Apr 20	-
11	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	CC159599 2015PSIG	Airgas an Air Liquide company	160-401526192-1	30 Jul 19	30 Jul 22	-
12	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920015	UAE Consultant Co., Ltd.	28032019	28 Apr 19	27 Apr 20	-
13	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1182920016	UAE Consultant Co., Ltd.	28032019	28 Apr 19	27 Apr 20	-

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Ambient									
14	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	CC159599 2015PSIG	Airgas an Air Liquide company	160-401526192-1	30 Jul 19	30 Jul 22	-
15	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORIBA	APHA-370 PDXEGXF7	UAE Consultant Co., Ltd.	16032019	16 Mar 19	15 Mar 20	-
16	Total Hydrocarbons Analyzer	Total Hydrocarbons	Thermo Scientific	55i 1182920025	UAE Consultant Co., Ltd.	23052019	23 May 19	22 May 20	-
17	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORIBA	APHA-370 SSGEJYBJ	UAE Consultant Co., Ltd.	17052019	17 May 19	16 May 20	-
18	Standard Gas	Total Hydrocarbons	Air Liquide	CC409260	RATA CLASS Dual-Analyzed Calibration Standard	09042013	9 Apr 13	10 Apr 21	-
21	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM13205	Calibration Laboratory Co.Ltd	Q19021060	22 Mar 19	21 Mar 20	-
22	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM13206	Calibration Laboratory Co.Ltd	Q19021061	22 Mar 19	21 Mar 20	-
20	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	SVANTEK	SV35A 73249	Electrical And Electronics Institute Foundation For Industrial Development	0394SV19	15 Oct 19	14 Oct 20	-
21	Sound Level Meter	$L_{Aeq\ 24\ hours}^1$, L_{Amax}^1 , $L_{Aeq\ 1\ hour}^1$, L_{A50} , L_{A90}	ACO	6236 172086	Quality Calibration Co., Ltd.	19E6565	11 Jul 19	10 Jul 20	-
22	Sound Level Meter	$L_{Aeq\ 24\ hours}^1$, L_{Amax}^1 , $L_{Aeq\ 1\ hour}^1$, L_{A50} , L_{A90}	ACO	6236 172085	Quality Calibration Co., Ltd.	19E6504	9 Jul 19	8 Jul 20	-

รายการใบรับรองสอบเทียบเครื่องมือหลักประจำห้องปฏิบัติการสำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือสำหรับวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Repeatability 0.1 mg)	ฝุ่นละอองขนาดไม่เกิน 10 ไมครอน (PM 10) ฝุ่นละอองรวม	Mettler-Toledo	AB204-S / 1128312528	National Food Institute, Ministry of Industry, Thailand Calibration Laboratory Mettler-Toledo (Thailand) Limited	200972-001-01 TH2027-047- 052819-ACC-TH	25 Dec 19 28 May 19	24 Dec 20 26 May 20	-
2	Analytical Balance (Repeatability 0.1 mg)		Mettler-Toledo	AB204-S/FACT / B108115858					

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

Calibration Certification Information			
Cal. Date: July 5, 2019	Rootmeter S/N: 438320	Ta: 29.6 °C	%
Operator: Jim Tisch		Pa: 753.1 mm Hg	
Calibration Model #: TE-5025A	Calibrator S/N: 3383		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4110	3.2	2.00
2	3	4	1	1.0000	6.3	4.00
3	5	6	1	0.8960	7.8	5.00
4	7	8	1	0.8520	8.7	5.50
5	9	10	1	0.7060	12.6	8.00

Data Tabulation			
Vstd (m3)	Qstd (x-axes)	$\sqrt{\Delta H \left(\frac{P_a}{P_{std}} \right) \left(\frac{T_{std}}{T_a} \right)}$ (y-axes)	Qa (x-axes)
0.9934	0.7040	1.4125	0.9958
0.9993	0.9993	1.9976	0.9916
0.9973	1.1019	2.2334	0.9896
0.9861	1.1574	2.3424	0.9834
0.9809	1.3894	2.8251	0.9833
QSTD	m= 2.06032 b= -0.03905 r= 0.99999	QA	m= 1.29014 b= -0.02451 r= 0.99999

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 = 1/m $\left(\sqrt{\Delta H \left(\frac{P_a}{P_{std}} \right) \left(\frac{T_{std}}{T_a} \right)} \right) - b$	Qa = 1/m $\left(\sqrt{\Delta H \left(\frac{P_a}{P_a} \right) \left(\frac{T_a}{T_a} \right)} \right) - b$

Standard Conditions	
Tstd: 298.15 °K	
Pstd: 760 mm Hg	
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: rootmeter manometer reading (in 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 51.1.1, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere 9.2.17, page 3G



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534 PANTAKARN ROAD SUKHUMVIT 24, SUKHUMVIT 24 BANGKOK 10259
TEL: 0-2713-0900 FAX: 0-2719-0444

Certificate of Calibration

Certificate No.: 20F576
Page: 1 of 2

Equipment: 1) Tube Manometer
Manufacturer: Oyster
Model: 1221-56-WIN
Serial No.:
ID No.: UAE EFM 02112500

Condition As-Received: Used Item
Received Date: 21 January 2020
Calibration Date: 03 February 2020
Reference: 2301-5310W5C
Ambient Temperature: 23 ± 2 °C
Relative Humidity: 50 ± 15 %
Atmospheric Pressure: 1039 mbar
Submitted by: United Analyst and Engineering Consultant Co., Ltd.
21 So Uttersakul 41, Sukhumvit Road, Bangkok, Pracharong, Bangkok 10269

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 guideline

Condition of this result of calibration

- Reference standards instruments:
- Pressure Calibrator
- The result of calibration was made on requested at the point specified by customer
- Scale and conversion factor is 1 kPa = 4.014753 in H2O
- The instrument was used clean air as pressure media
- This instrument was included in vertical orientation and top of the pressure port was used as the reference level
- This result of calibration was found accurate as shown on date and place of calibration only
- This Calibration is traceable to the International System of Unit maintained at:-

National Institute of Metrology, Thailand (NIMT)

Calibrated by: Nongnong Phosang
Issue Date: 05 February 2020
Approved Signatory: *Atteya P*
1) Phasine Phosang
1) Sura Sawanach
1) Adapat Pansach



Cert. No.: 20P576

Page: 2 of 2

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

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

Applied Pressure (inH ₂ O)	High-port side (inH ₂ O)	UUC Indication		Error (inH ₂ O)
		Low-port side (inH ₂ O)	ΔP (inH ₂ O)	
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-0.98	1.98	-0.02
4.00	2.00	-1.98	3.98	-0.02
6.00	3.00	-2.98	5.98	-0.02
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-5.00	10.00	0.00
12.00	6.00	-6.00	12.00	0.00
14.00	7.00	-7.00	14.00	0.00
16.00	8.04	-8.04	16.08	0.04
18.00	9.04	-9.02	18.06	0.06
20.00	10.04	-10.02	20.06	0.06
22.00	11.04	-11.02	22.06	0.06
24.00	12.06	-12.04	24.10	0.10
26.00	13.06	-13.04	26.10	0.10
28.00	14.06	-14.04	28.10	0.10
30.00	15.06	-15.04	30.10	0.10
32.00	16.08	-16.04	32.12	0.12
34.00	17.08	-17.04	34.12	0.12
35.80	18.00	-17.92	35.92	0.12

* ΔP = High-port side - Low-port side

The uncertainty of measurement was ± 0.11 inH₂O

* UUC = Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAI AND JAPAN)

CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
434 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10500

TEL: 0-217-8000-24 FAX: 0-27104484



THAI AND JAPAN
CALIBRATION 2021

Certificate of Calibration

Certificate No.: 20P565

Page: 1 of 2

Equipment: Aneroid Barometer

Manufacturer: Bango

Model:

Serial No.:

ID No.: UAE-ANV-0122547

Condition As-Received: Used item

Received Date: 03 February 2020

Calibration Date: 10 February 2020

Reference: 2002-0052WSC

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

84 Soi Udonasak 41, Sukhumvit Road, Bangkok,

Phrahanong, 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 "DIN 61 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

DP142

142205346

MP-0059-19

20 Mar 2020

2 The 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 The instrument was used clean air as pressure media

6 The result of calibration was found accurate as shown on date and place of calibration only.

7 This Certificate is traceable to the International System of Unit maintained at:

National Institute of Metrology, Thailand (NIMT)

Calibrated by: Nopparat Phongam

Issue Date: 12 February 2020

Approved Signatory: *Atsapol P.*

1) Phatree Pradapal

1) Eua Suwanast

1) Atsapol Pannach

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Cert. No.: 20P555
Page: 2 of 2

Result of calibration:- Without adjustment
Function:- Absolute Pressure Measurement
Range: 720 mmHg to 760 mmHg
Scale Interval: 1 mmHg (The Full Estimate)

Increasing Pressure									
Applied Pressure (mmHg)	716.04	729.07	739.52	749.81	760.08	770.72	782.45		
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0		
Error (mmHg)	1.96	0.93	0.48	0.19	-0.08	-0.72	-2.45		
Decreasing Pressure									
Applied Pressure (mmHg)	782.46	770.73	760.05	749.71	739.38	729.09	718.09		
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0		
Error (mmHg)	-2.46	-0.73	-0.05	0.29	0.62	1.00	1.91		

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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
811 PATTANAKARN ROAD NO.18, SHANGHAI ESTATE, SUKHUMVIT ROAD, BANGKOK 10260
TEL: 0-2717-3000, 24-44 0-2717-3044, 44



Certificate of Calibration

Certificate No.: 20H404
Page: 1 of 2

Equipment: End Thermohygrometer
Manufacturer: Bargo
Model:
Serial No.:
ID No.: LAE RVV 003/2545
Condition As-Received: Used Item
Received Date: 03 February 2020
Calibration Date: 05 February 2020
Reference: 2032-0051WSC
Ambient Temperature: 25 ± 3 °C
Relative Humidity: (50 ± 20) %
Submitted by: United Analyst and Engineering Consultant Co. Ltd
81 Soi Ubonruek 41, Sukhumvit Road, Bangkok,
Phrahanong Bangkok 10260

Procedure used: Calibration was 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) Humidity Transducer With Sensor	1521	AGA339	16667	17 Jul 2020
2) Chilled Mirror Hygrometer	Des Model	44733	17017	07 Mar 2020

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

3 This Calibration is traceable to the International System of Unit (SI) maintained at:

National Institute of Metrology Thailand (NIMT)

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

Calibrated by: Suratt Phansathaporn
Issue Date: 20 February 2020

Approved Signatory:

1/1 Chaita Wawongkajana
1/1 Pongthana Tanayakul
1/1 Paitak Somsongkol

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Cert. No.: 20H404
Page: 2 of 2

Result of Calibration:-

Function:

Before Adjustment

Humidity measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
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25.0	40.1	56.5	16.4	1.5
25.0	60.0	61.0	1.0	1.7
25.0	80.0	65.0	-15.0	1.7

Result of Calibration:-

Function:

After Adjustment

Humidity measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
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25.0	40.1	55.5	15.4	1.5
25.0	60.0	60.0	0.0	1.7
25.0	80.0	63.5	-16.5	1.7

Result of Calibration:-

Function:

Before Adjustment

Temperature measurement

Reference Temperature (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
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25.0	20.032	20.0	-0.032	0.72
25.0	25.002	25.0	-0.002	0.72
25.0	30.012	30.5	0.488	0.72
25.0	35.008	35.5	0.432	0.72
25.0	40.039	41.0	0.961	0.72

Result of Calibration:-

Function:

After Adjustment

Temperature measurement

Reference Temperature (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
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25.0	20.019	20.0	-0.019	0.72
25.0	25.031	25.0	-0.031	0.72
25.0	29.975	30.0	0.025	0.72
25.0	35.033	35.5	0.467	0.72
25.0	39.989	41.0	1.011	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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United Analyst and Engineering Consultant Co., Ltd.

350 Highway 41, Suburbs Road, Bangkok 10160

Tel : 02-763-1218 Fax : 02-763-2800 www.unaeconsult.com E-mail : unaeconsult@unaeconsult.com

MULTI-POINT GAS TEST REPORT

Test Date : May 06, 2019

Equipment : Gas Analyzer (CO)
Manufacturer : Thermo
Model : 48C
Serial Number : 48CTL 65506-348

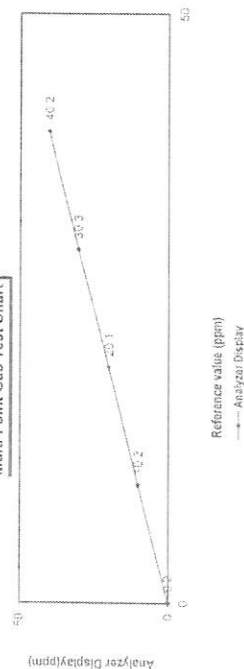
Standard Gas Concentration

Standard Gas Concentration	ppm	Dilutor Detail
Sulphur Dioxide (SO ₂)	45.23	Manufacturer: API
Nitric Oxide (NO)	45.55	Model: 700
Methane (CH ₄)	504.6	Serial Number: 886
Carbon Monoxide (CO)	5003	
Cylinder No. :	CC112620	
Expiration Date :	Jun 15, 2020	

Multi-point gas test data

Level	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	25.0	0.2	0.2	0.2	0.2
Level 2	20.00%	10.2	0.2	2.0	2.0
Level 3	40.00%	20.1	0.1	0.5	0.5
Level 4	60.00%	30.3	0.3	1.0	1.0
Level 5	80.00%	40.2	0.2	0.5	0.5
Remark : Measuring Range 50.0 ppm					0.63
Acceptable Limit ± 5%					

Multi-Point Gas Test Chart



Calculate by

Sutthai Sangsri
8 May 2019

Approve by

Sutthai Sangsri
8 May 2019

Tel: 0 2763 2828 Fax: 0 2763 2690 www.ubm.co.uk

MULTI-POINT GAS TEST REPORT

Test Date : May 6, 2019

Equipment:	Gas Analyzer (CO)	Model:	48C
Manufacturer:	Thermo	Serial Number:	48C-7

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	45.23	PPM	Manufacturer :
Nitric Oxide (NO)	45.55	PPM	Model :
Methane (CH ₄)	504.6	PPM	Serial Number :
Carbon Monoxide (CO)	5003	PPM	

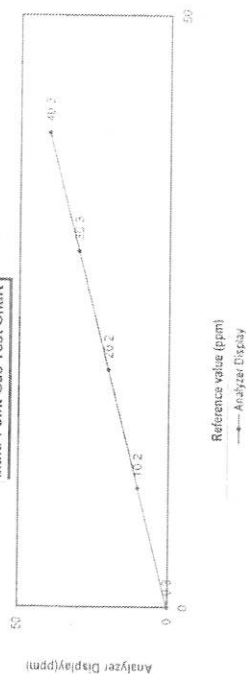
Expiration Date : Jun 15, 2020

Multi-point gas test data

Reference Value (ppm)		Analyzer Display (ppm)	Difference Error	Percent Error	% Error
Level 1	Zero	0.0	0.3	0.3	0.3
Level 2	20.00%	19.0	10.2	0.2	2.0
Level 3	40.00%	20.0	20.2	1.0	1.0
Level 4	60.00%	30.0	30.3	0.3	1.0
Level 5	80.00%	40.0	0.2	0.5	0.5
Remark : Measuring Range		50.0 ppm	Average Difference (%)		0.95

Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart (



Calculate by

Calculate by
Sridhar Yungar
31 May 2019

Approve by _____

Approve by _____

 8, May, 2019

อนาธิปไตย



1. $\frac{1}{2} \log \frac{1}{2}$
 2. $\frac{1}{2} \log \frac{1}{2}$
 3. $\frac{1}{2} \log \frac{1}{2}$
 4. $\frac{1}{2} \log \frac{1}{2}$
 5. $\frac{1}{2} \log \frac{1}{2}$
 6. $\frac{1}{2} \log \frac{1}{2}$
 7. $\frac{1}{2} \log \frac{1}{2}$
 8. $\frac{1}{2} \log \frac{1}{2}$
 9. $\frac{1}{2} \log \frac{1}{2}$
 10. $\frac{1}{2} \log \frac{1}{2}$

CERTIFICATE OF ANALYSIS

Part Number	EQ4999SE15A0102	Reference Number	150-4616526192-1
Cylinder Number	CO156999	Cylinder Volume	144.4 CF
Laboratory	1-4 - Plumsteadville - PA	Cylinder Pressure	231F PSIG
Lab Number	A1-019	Valve Outlet	650
Gas Type	CO NOX SO2 BALN	Collection Date	Jul 30 2019

Expiration Date: Jul 30, 2022

Confidentiality is a common theme shared with this community. In addition, a Confidentiality Agreement is a standard requirement for all employees. The Confidentiality Agreement is a document that is signed by all employees and is a part of the employee's contract. The Confidentiality Agreement is a document that is signed by all employees and is a part of the employee's contract. The Confidentiality Agreement is a document that is signed by all employees and is a part of the employee's contract.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
ALA	26.00 μ M	44.75 μ M	3 ^a	-0.3% -18.5% Traceable	07/23/09, 07/30/09
ASPEN, PALL	26.00 μ M	44.75 μ M	3 ^a	-0.3% -18.5% Traceable	07/23/09, 07/30/09
5-ALA, PALL	47.00 μ M	47.75 μ M	3 ^a	-0.3% -18.5% Traceable	07/23/09, 07/30/09
ASPEN, MCKINLEY	100.00 μ M	101.75 μ M	3 ^a	-0.3% -18.5% Traceable	07/23/09, 07/30/09
ASPEN, MCKINLEY	100.00 μ M	101.75 μ M	3 ^a	-0.3% -18.5% Traceable	07/23/09, 07/30/09

CALIBRATION STANDARDS

Type	LotID	Cylinder No.	Concentration	Uncertainty	Expiration Date
SI-M	634523	634503A	247.6 ppm MATRIC CARBONITROGEN	± 0.4%	Nov 03 2023
SI-M	634524	634504A2	63.33 ppm MATRIC CARBONITROGEN	± 0.4%	Mar 12 2024
SI-M	634525	634505A	23.9 ppm MATRIC CARBONITROGEN	± 0.4%	Feb 08 2023
SI-M	634526	634506A2	23.9 ppm MATRIC CARBONITROGEN	± 0.4%	Mar 12 2024
SI-M	634527	634507A3	43.67 ppm SI-MUR CARBONITROGEN	± 1.3%	Jan 20 2022
SI-M	634528	634508A3	43.67 ppm SI-MUR CARBONITROGEN	± 0.4%	Mar 20 2021

ANALYTICAL EQUIPMENT

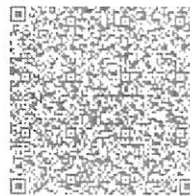
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Final Data Available Upon Request

NOTES: $\text{P}(\text{A}_1) = 1/3$, $\text{P}(\text{A}_2) = 1/3$, $\text{P}(\text{A}_3) = 1/3$

THE UNIVERSITY OF CHICAGO

12	10
11	20
10	30
9	40
8	50
7	60
6	70
5	80
4	90
3	100
2	110
1	120



Signature on file.....

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RESEARCH CLUB

MULTI-POINT GAS TEST REPORT

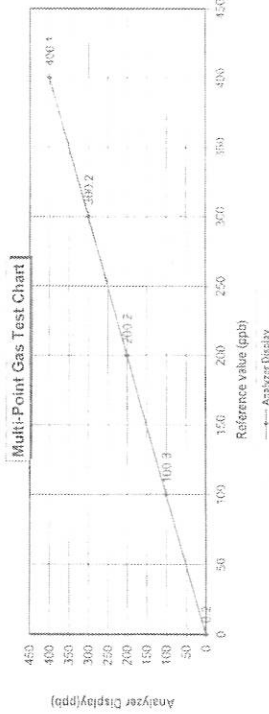
Test Date : Apr 24, 2019

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Environmental Instruments Serial Number : 42C-78933-390

Standard Gas Concentration
Sulphur Dioxide (SO₂) 45.23 Thermo Scientific
Nitric Oxide (NO) 45.55 146i
Methane (CH₄) 504.6 1180540071
Carbon Monoxide (CO) 5003
Cylinder No. : CC112620
Expiration Date : Jun 15, 2020

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	% Error
Level 1	Zero	0.2	0.20	0.20	0.20
Level 2	20.00%	100.3	0.30	0.30	0.30
Level 3	40.00%	200.2	0.20	0.10	0.10
Level 4	60.00%	300.2	0.20	0.07	0.07
Level 5	80.00%	400.1	0.10	0.02	0.02
Remark : Measuring Range 500.0 ppb					0.14
Acceptable Limit \pm 5%					
Average Difference (%)					0.14



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Signature: [Signature]
Date: 24 Apr 2019

MULTI-POINT GAS TEST REPORT

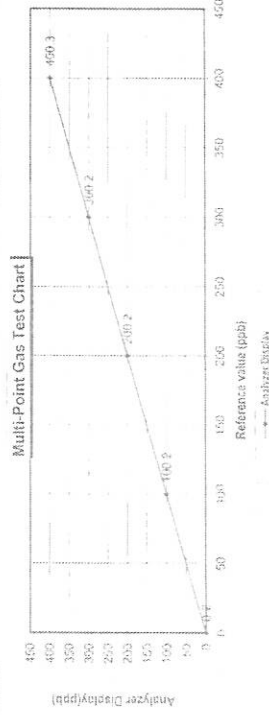
Test Date : Apr 24, 2019

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

Standard Gas Concentration
Sulphur Dioxide (SO₂) 45.23 Thermo Scientific
Nitric Oxide (NO₂) 45.55 146i
Methane (CH₄) 504.6 1180540071
Carbon Monoxide (CO) 5003
Cylinder No. : CC112620
Expiration Date : Jun 15, 2020

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	% Error
Level 1	Zero	0.2	0.20	0.20	0.20
Level 2	20.00%	100.2	0.20	0.20	0.20
Level 3	40.00%	200.2	0.20	0.10	0.10
Level 4	60.00%	300.2	0.20	0.07	0.07
Level 5	80.00%	400.3	0.30	0.07	0.07
Remark : Measuring Range 500.0 ppb					0.13
Acceptable Limit \pm 5%					
Average Difference (%)					0.13



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Signature: [Signature]
Date: 24 Apr 2019

MULTI-POINT GAS TEST REPORT

Test Date : Apr 28, 2019

Equipment : Gas Analyzer (SO₂)
Manufacturer : Thermo Scientific

Model : 43i
Serial Number : 1182920016

Standard Gas Concentration

Sulphur Dioxide (SO₂) 45.23
Nitric Oxide (NO) 45.55
Methane (CH₄) 504.6
Carbon Monoxide (CO) 5003
Cylinder No. : CC112620
Expiration Date : Jun 15, 2020

Diluter Detail

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

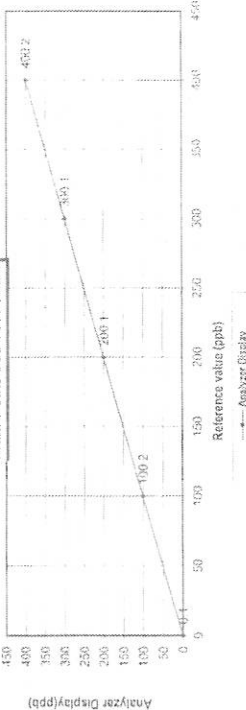
Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.1	0.10	0.10	0.10
Level 2	20.00%	100.2	0.20	0.20	0.20
Level 3	40.00%	200.1	0.10	0.05	0.05
Level 4	60.00%	300.1	0.10	0.03	0.03
Level 5	80.00%	400.2	0.20	0.05	0.05

Remark : Measuring Range 500.0 ppb

Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



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28/4/19

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28/4/19

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number : E04N168F16A010C
Cylinder Number : CC159559
Laboratory : 124 - Plumsteadville - PA
FCVP Number : A12019
Gas Code : C0 NO HCN SO2 BALN
Reference Number : 160-401628192-1
Cylinder Volume : 144.4 CF
Cylinder Pressure : 2015 PSIG
Valve Outlet : 660
Certification Date : Jul 30, 2019
Expiration Date : Jul 30, 2022

Analysis performed in accordance with EPA Method 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 21I, 21J, 21K, 21L, 21M, 21N, 21O, 21P, 21Q, 21R, 21S, 21T, 21U, 21V, 21W, 21X, 21Y, 21Z, 21AA, 21AB, 21AC, 21AD, 21AE, 21AF, 21AG, 21AH, 21AI, 21AJ, 21AK, 21AL, 21AM, 21AN, 21AO, 21AP, 21AQ, 21AR, 21AS, 21AT, 21AU, 21AV, 21AW, 21AX, 21AY, 21AZ, 21BA, 21BB, 21BC, 21BD, 21BE, 21BF, 21BG, 21BH, 21BI, 21BJ, 21BK, 21BL, 21BM, 21BN, 21BO, 21BP, 21BQ, 21BR, 21BS, 21BT, 21BU, 21BV, 21BW, 21BX, 21BY, 21BZ, 21CA, 21CB, 21CC, 21CD, 21CE, 21CF, 21CG, 21CH, 21CI, 21CJ, 21CK, 21CL, 21CM, 21CN, 21CO, 21CP, 21CQ, 21CR, 21CS, 21CT, 21CU, 21CV, 21CW, 21CX, 21CY, 21CZ, 21DA, 21DB, 21DC, 21DD, 21DE, 21DF, 21DG, 21DH, 21DI, 21DJ, 21DK, 21DL, 21DM, 21DN, 21DO, 21DP, 21DQ, 21DR, 21DS, 21DT, 21DU, 21DV, 21DW, 21DX, 21DY, 21DZ, 21EA, 21EB, 21EC, 21ED, 21EE, 21EF, 21EG, 21EH, 21EI, 21EJ, 21EK, 21EL, 21EM, 21EN, 21EO, 21EP, 21EQ, 21ER, 21ES, 21ET, 21EU, 21EV, 21EW, 21EX, 21EY, 21EZ, 21FA, 21FB, 21FC, 21FD, 21FE, 21FF, 21FG, 21FH, 21FI, 21FJ, 21FK, 21FL, 21FM, 21FN, 21FO, 21FP, 21FQ, 21FR, 21FS, 21FT, 21FU, 21FV, 21FW, 21FX, 21FY, 21FZ, 21GA, 21GB, 21GC, 21GD, 21GE, 21GF, 21GG, 21GH, 21GI, 21GJ, 21GK, 21GL, 21GM, 21GN, 21GO, 21GP, 21GQ, 21GR, 21GS, 21GT, 21GU, 21GV, 21GW, 21GX, 21GY, 21GZ, 21HA, 21HB, 21HC, 21HD, 21HE, 21HF, 21HG, 21HH, 21HI, 21HJ, 21HK, 21HL, 21HM, 21HN, 21HO, 21HP, 21HQ, 21HR, 21HS, 21HT, 21HU, 21HV, 21HW, 21HX, 21HY, 21HZ, 21IA, 21IB, 21IC, 21ID, 21IE, 21IF, 21IG, 21IH, 21II, 21IJ, 21IK, 21IL, 21IM, 21IN, 21IO, 21IP, 21IQ, 21IR, 21IS, 21IT, 21IU, 21IV, 21IW, 21IX, 21IY, 21IZ, 21JA, 21JB, 21JC, 21JD, 21JE, 21JF, 21JG, 21JH, 21JI, 21JJ, 21JK, 21JL, 21JM, 21JN, 21JO, 21JP, 21JQ, 21JR, 21JS, 21JT, 21JU, 21JV, 21JW, 21JX, 21JY, 21JZ, 21KA, 21KB, 21KC, 21KD, 21KE, 21KF, 21KG, 21KH, 21KI, 21KJ, 21KK, 21KL, 21KM, 21KN, 21KO, 21KP, 21KQ, 21KR, 21KS, 21KT, 21KU, 21KV, 21KW, 21KX, 21KY, 21KZ, 21LA, 21LB, 21LC, 21LD, 21LE, 21LF, 21LG, 21LH, 21LI, 21LJ, 21LK, 21LL, 21LM, 21LN, 21LO, 21LP, 21LQ, 21LR, 21LS, 21LT, 21LU, 21LV, 21LW, 21LX, 21LY, 21LZ, 21MA, 21MB, 21MC, 21MD, 21ME, 21MF, 21MG, 21MH, 21MI, 21MJ, 21MK, 21ML, 21MN, 21MO, 21MP, 21MQ, 21MR, 21MS, 21MT, 21MU, 21MV, 21MW, 21MX, 21MY, 21MZ, 21NA, 21NB, 21NC, 21ND, 21NE, 21NF, 21NG, 21NH, 21NI, 21NJ, 21NK, 21NL, 21NM, 21NO, 21NP, 21NQ, 21NR, 21NS, 21NT, 21NU, 21NV, 21NW, 21NX, 21NY, 21NZ, 21OA, 21OB, 21OC, 21OD, 21OE, 21OF, 21OG, 21OH, 21OI, 21OJ, 21OK, 21OL, 21OM, 21ON, 21OO, 21OP, 21OQ, 21OR, 21OS, 21OT, 21OU, 21OV, 21OW, 21OX, 21OY, 21OZ, 21PA, 21PB, 21PC, 21PD, 21PE, 21PF, 21PG, 21PH, 21PI, 21PJ, 21PK, 21PL, 21PM, 21PN, 21PO, 21PP, 21PQ, 21PR, 21PS, 21PT, 21PU, 21PV, 21PW, 21PX, 21PY, 21PZ, 21QA, 21QB, 21QC, 21QD, 21QE, 21QF, 21QG, 21QH, 21QI, 21QJ, 21QK, 21QL, 21QM, 21QN, 21QO, 21QP, 21QQ, 21QR, 21QS, 21QT, 21QU, 21QV, 21QW, 21QX, 21QY, 21QZ, 21RA, 21RB, 21RC, 21RD, 21RE, 21RF, 21RG, 21RH, 21RI, 21RJ, 21RK, 21RL, 21RM, 21RN, 21RO, 21RP, 21RQ, 21RR, 21RS, 21RT, 21RU, 21RV, 21RW, 21RX, 21RY, 21RZ, 21SA, 21SB, 21SC, 21SD, 21SE, 21SF, 21SG, 21SH, 21SI, 21SJ, 21SK, 21SL, 21SM, 21SN, 21SO, 21SP, 21SQ, 21SR, 21SS, 21ST, 21SU, 21SV, 21SW, 21SX, 21SY, 21SZ, 21TA, 21TB, 21TC, 21TD, 21TE, 21TF, 21TG, 21TH, 21TI, 21TJ, 21TK, 21TL, 21TM, 21TN, 21TO, 21TP, 21TQ, 21TR, 21TS, 21TT, 21TU, 21TV, 21TW, 21TX, 21TY, 21TZ, 21UA, 21UB, 21UC, 21UD, 21UE, 21UF, 21UG, 21UH, 21UI, 21UJ, 21UK, 21UL, 21UM, 21UN, 21UO, 21UP, 21UQ, 21UR, 21US, 21UT, 21UU, 21UV, 21UW, 21UX, 21UY, 21UZ, 21VA, 21VB, 21VC, 21VD, 21VE, 21VF, 21VG, 21VH, 21VI, 21VJ, 21VK, 21VL, 21VM, 21VN, 21VO, 21VP, 21VQ, 21VR, 21VS, 21VT, 21VU, 21VV, 21VW, 21VX, 21VY, 21VZ, 21WA, 21WB, 21WC, 21WD, 21WE, 21WF, 21WG, 21WH, 21WI, 21WJ, 21WK, 21WL, 21WM, 21WN, 21WO, 21WP, 21WQ, 21WR, 21WS, 21WT, 21WU, 21WV, 21WW, 21WX, 21WY, 21WZ, 21XA, 21XB, 21XC, 21XD, 21XE, 21XF, 21XG, 21XH, 21XI, 21XJ, 21XK, 21XL, 21XM, 21XN, 21XO, 21XP, 21XQ, 21XR, 21XS, 21XT, 21XU, 21XV, 21XW, 21XX, 21XY, 21XZ, 21YA, 21YB, 21YC, 21YD, 21YE, 21YF, 21YG, 21YH, 21YI, 21YJ, 21YK, 21YL, 21YM, 21YN, 21YO, 21YP, 21YQ, 21YR, 21YS, 21YT, 21YU, 21YV, 21YW, 21YX, 21YY, 21YZ, 21ZA, 21ZB, 21ZC, 21ZD, 21ZE, 21ZF, 21ZG, 21ZH, 21ZI, 21ZJ, 21ZK, 21ZL, 21ZM, 21ZN, 21ZO, 21ZP, 21ZQ, 21ZR, 21ZS, 21ZT, 21ZU, 21ZV, 21ZW, 21ZX, 21ZY, 21ZZ

See Test Log 1, Gas Cylinder below, 100 PPM, up to 2000 PPM, 25

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
NOX	45.00 PPM	44.76 PPM	51	$\pm 0.0\%$ NIST Traceable	07/23/2019, 07/23/2019
AMERIC OXIDE	45.00 PPM	44.76 PPM	51	$\pm 0.0\%$ NIST Traceable	07/23/2019, 07/23/2019
SULFUR DIOXIDE	45.00 PPM	45.35 PPM	51	$\pm 0.0\%$ NIST Traceable	07/23/2019, 07/23/2019
CARBON MONOXIDE	1000 PPM	1007 PPM	51	$\pm 0.0\%$ NIST Traceable	07/23/2019
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NITRO	6830121	KAL004216	250.0 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	50.0 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	25.0 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	12.5 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	6.25 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	3.125 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	1.5625 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023
NITRO	6830121	KAL004216	0.78125 PPM NITRIC OXIDE/NITROGEN	$\pm 0.4\%$	Nov 08, 2023

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO METER, FUR 0002502	FTIR	Jul 19, 2019
NO METER, FUR 0002502	FTIR	Jul 22, 2019
NO METER, FUR 0002502	FTIR	Jul 22, 2019
SO ₂ METER, FUR 0002502	FTIR	Jul 22, 2019

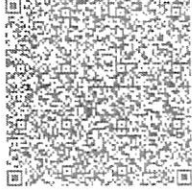
Triad Data Available Upon Request

NOTES: RAN# 51119-C1402

PC# 401500210

GROSS WEIGHT 28.6 KG

NET WEIGHT 4.1 KG



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United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Tel 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Mar 14, 2019

Equipment : Gas Analyzer (Hydrocarbon)
Manufacturer : HORIBA Model : APHA-370
Serial Number : PDXEGX7

Standard Gas Concentration
Sulphur Dioxide (SO₂) 45.23
Nitric Oxide (NO) 45.55
Methane (CH₄) 504.6
Carbon Monoxide (CO) 5003
Cylinder No. : CCI12620
Expiration Date : Jun 15, 2020

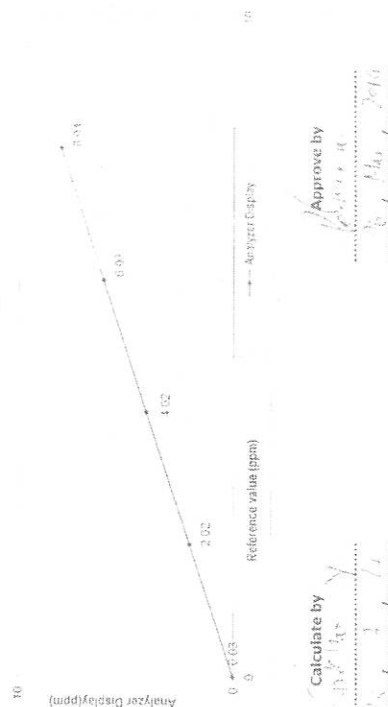
Dilutor Detail
PPM Manufacturer
PPM Model
PPM Serial Number
PPM Serial Number

Thermo SCIENTIFIC
146i
1180540071

Multi-point gas test data

Level	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.03	0.03	0.03	0.03
Level 2	20.00%	2.02	0.02	0.99	0.99
Level 3	40.00%	4.02	0.02	0.50	0.50
Level 4	60.00%	6.03	0.03	0.50	0.50
Level 5	80.00%	8.04	0.04	0.50	0.50
Remark	Measuring Range 10.00 ppm				
Acceptable Limit $\pm 5\%$					0.50

Multi-Point Gas Test Chart



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United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Tel 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : May 22, 2019

Equipment : Gas Analyzer (Hydrocarbon)
Manufacturer : Thermo SCIENTIFIC Model : 55i
Serial Number : 1182920025

Standard Gas Concentration
Sulphur Dioxide (SO₂) 45.23
Nitric Oxide (NO) 45.55
Methane (CH₄) 504.6
Carbon Monoxide (CO) 5003
Cylinder No. : CCI12620
Expiration Date : Jun 15, 2020

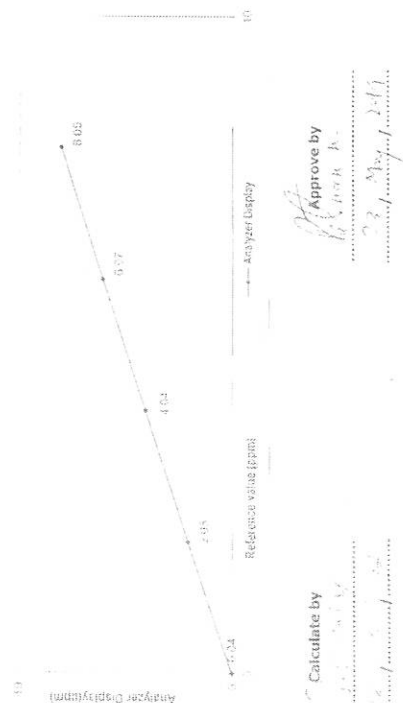
Dilutor Detail
PPM Manufacturer
PPM Model
PPM Serial Number
PPM Serial Number

Thermo SCIENTIFIC
146i
1180540071

Multi-point gas test data

Level	Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.03	0.04	0.64	0.04
Level 2	20.00%	2.05	0.05	2.44	2.44
Level 3	40.00%	4.04	0.04	0.99	0.99
Level 4	60.00%	6.07	0.07	1.15	1.15
Level 5	80.00%	8.05	0.05	0.62	0.62
Remark	Measuring Range 10.00 ppm				
Acceptable Limit $\pm 5\%$					1.05

Multi-Point Gas Test Chart



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MULTI-POINT GAS TEST REPORT

Test Date : May 15, 2019

Equipment: Gas Analyzer (Hydrocarbon)
Manufacturer: HORIBA

Model: APHA-370
Serial Number: SSGEYB1

Standard Gas Concentration

PPM	Manufacturer	Model	Serial Number
45.23	Sulphur Dioxide (SO ₂)	1461	1180540071
45.55	Nitric Oxide (NO)		
504.6	Methane (CH ₄)		
5003	Carbon Monoxide (CO)		

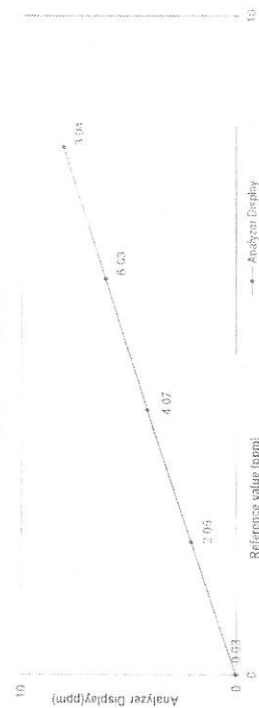
Expiration Date : Jun 15, 2020

Multi-point gas test data

Reference Value (ppm)		Analyzer Display (ppm)	Difference Error	Percent Error	% Error }
Level 1	Zero	0.03	0.03	6.03	6.03
Level 2	20.00%	2.00	2.05	0.05	2.44
Level 3	40.00%	4.00	4.07	0.07	1.72
Level 4	60.00%	6.00	6.03	0.03	0.50
Level 5	80.00%	8.04	0.04	0.50	0.50
Remark : Measuring Range		10.00 ppm	Average Difference (%)		1.04

Acceptable Limit + 5%

Multi-Point Gas Test Chart





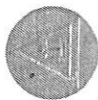
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19.5.61
W. J. G.

Approved by _____

12 July 1999

 AIR LIQUIDE Air Liquide America Specialty Gases LLC Intertek		RATA CLASS <i>Dual-Analyzed Calibration Standard</i>	
8832 DICE ROAD, SANTA FE SPRINGS, CA 90670-2516 Phone: 800-323-2212 Fax: 562-484-5262			
CERTIFICATE OF ACCURACY: EPA Protocol Gas			
Assay Laboratory - RGVF Vander ID: A52013 AIR LIQUIDE AMERICA SPECIALTY GASES LLC 8832 DICE ROAD SANTA FE SPRINGS, CA 90670-2516		P.O. No.: 12103783 Document #: 5009089 001	
ANALYTICAL INFORMATION Gas Type: CH4 BALA This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure G-1; September, 1997. Cylinder Number: CC409260 Cylinder Pressure: 2000 PSIG		Customer: AIR LIQUIDE (THAILAND) LTD KANDITHA THIRAFUJCHUPO 12 80/3, 14/F VORAWAT BLDG. U SLOM ROAD, BANGNAK THAILAND	
COMPONENT METHANE		Exp. Date: 10Apr2011 Batch No: SB00067973	
CERTIFIED CONCENTRATION (Moles) 8.16 PPM BALANCE		ACCURACY** +/- 1%	
TRACEABILITY Direct NIST and VSL			
... Do not use when cylinder pressure is below 150 psig; ... Analytical accuracy is based on the requirements of EPA Protocol Procedure G1, September 1997.			
REFERENCE STANDARD TYPE/GRM NO. NTRM 1459 EXPIRATION DATE 18MAR2016		CONCENTRATION 10.40 PPM	
INSTRUMENTATION INSTRUMENT/MODEL/SERIAL# GC-1/COUP 5890 H2/140A38374		DATE LAST CALIBRATED 09Apr2013	
ANALYZER READINGS 12 = Zero Gas R = Reference Gas T = Test Gas T = Correlation Coefficient		ANALYTICAL PRINCIPLE GC	
First Triad Analysis		Second Triad Analysis	
METHANE Date: 09Apr2013 Response Unit: AREA Z1 = 0.00000 R1 = 119559.0 T1 = 91585.00 R2 = 116492.0 Z2 = 0.00000 T2 = 91597.00 Z3 = 0.00000 T3 = 91586.00 R3 = 115195.0 Avg. Concentration: 8.160 PPM		Calibration Curve Concentration = A + Bx + Cx2 + Dx3 + Ex4 r = 0.985938 1659 Constants: A = -0.02914179 B = 0.0000997034 C = D = E =	
Special Notes: APPROVED BY: 		GROSS: 26.909 kg TARE: 21.0039 kg NET: 5.9052 kg PART QUOTE 0105111001	



CALIBRATION LABORATORY CO., LTD.

21/101 หมู่ 10 ซ.บางนา-ตราด 10 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110
Tel : 02-556-2525 Fax : 02-556-2525 E-mail : info@cll.co.th



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UMI3205/UMI3205
CLID. NO. : 251900275
JOB CONTROL NO. : 190320021060

CUSTOMER : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK, PHRAKHANG, BANGKOK 10260

DATE OF RECEIVED : 20 March 2019

DATE OF ISSUED : 22 March 2019

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By :

Suwit Phuanbusabong

Technician

Approved By :

Somsak Yotsoontorn

Authorized Signatory

22 March 2019

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q19021600

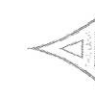
F3-011-04/01-12

เอกสารนี้ควบคุม
Page 1 of 3



CALIBRATION LABORATORY CO., LTD.

21/101 หมู่ 10 ซ.บางนา-ตราด 10 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110
Tel : 02-556-2525 Fax : 02-556-2525 E-mail : info@cll.co.th



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UMI3205/UMI3205
DATE OF CALIBRATION : 21 March 2019

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$

Relative Humidity : $(55 \pm 15) \%RH$

PROCEDURE USED :

This instrument was calibrated under procedure No. WI-305-127 according to ISO 16063-21 as calibration guideline. This calibration was performed by comparison method and standard equipments maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

1. The 13 Multimeter, HP Model 34401A S.N. 1 S36034686
2. Programmable Function Generator, Phisat Model PX6050 S.N. SM578571
3. Accelerometer with Measuring Amplifier, Bruel & Kjaer Model 8305, 2822 S.N. 197018, 2434988

TRACEABILITY :

1. The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. 11-0506-18, Due date 01 May 2019.
2. The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. 11-0501-18, Due date 31 October 2019.
3. The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. 11-0501-18, Due date 31 June 2019.

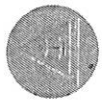
UNCERTAINTY :

The reported expanded uncertainty of the measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %. The measurement is calculated according to the "Evaluation of the Uncertainty of Measurement in Calibration" (JAF 4-02 M:2013).

Certificate No. Q19021600

F3-011-04/01-12

เอกสารนี้ควบคุม
Page 2 of 4



CALIBRATION LABORATORY CO., LTD.

270/51-52/55 หมู่ 5 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพมหานคร 10130
Tel: 02-5791041-4 Fax: 02-5791042 E-mail: info@clc.co.th



CALIBRATION LABORATORY CO., LTD.

270/51-52/55 หมู่ 5 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพมหานคร 10130
Tel: 02-5791041-4 Fax: 02-5791042 E-mail: info@clc.co.th

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (N) without adjustment () adjustment

CALIBRATION DATA

1. ACCELERATION RESULT

Test point (g)	(frequency)	Mode	STD Reading (g)	D/C Reading (g)	Correction (g)	Uncertainty \pm (%)
1	160 Hz	peak	1.000	0.911	-0.089	1.3
2	160 Hz		2.000	1.808	-0.192	1.0
3	160 Hz		3.000	2.744	-0.256	1.0
4	160 Hz		4.000	3.712	-0.288	1.0
5	160 Hz		5.000	4.654	-0.346	1.0
1	50 Hz	peak	1.000	1.013	+0.013	1.3
2	50 Hz		2.000	2.023	+0.023	1.0
3	50 Hz		3.000	3.025	+0.025	1.0
4	50 Hz		4.000	4.034	+0.034	1.0
5	50 Hz		5.000	5.042	+0.042	1.0

2. VELOCITY RESULT

Test point (mm/s)	(frequency)	Mode	STD Reading (mm/s)	D/C Reading (mm/s)	Correction (mm/s)	Uncertainty \pm (%)
10	160 Hz	peak	10.000	9.950	-0.050	1.3
20	160 Hz		20.000	19.379	-0.621	1.0
30	160 Hz		30.000	28.745	-1.255	1.0
10	50 Hz	peak	10.000	10.021	+0.021	2.3
20	50 Hz		20.000	20.035	+0.035	1.8
30	50 Hz		30.000	30.053	+0.053	1.0

Certificate No. Q19021060

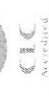
F3-011-04-01-12

เอกสารใบกำกับ
Page 1 of 4



CALIBRATION LABORATORY CO., LTD.

270/51-52/55 หมู่ 5 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพมหานคร 10130
Tel: 02-5791041-4 Fax: 02-5791042 E-mail: info@clc.co.th



CALIBRATION LABORATORY CO., LTD.

270/51-52/55 หมู่ 5 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพมหานคร 10130
Tel: 02-5791041-4 Fax: 02-5791042 E-mail: info@clc.co.th

CALIBRATION DATA

3. DISPLACEMENT RESULT

Test point (mm)	(frequency)	Mode	STD Reading (mm)	D/C Reading (mm)	Correction (mm)	Uncertainty \pm (%)
0.01	160 Hz	peak	0.010	0.010	0.000	5.9
0.02	160 Hz		0.020	0.020	0.000	3.1
0.03	160 Hz		0.030	0.030	0.000	2.2
0.04	160 Hz		0.040	0.041	+0.001	1.7
0.05	160 Hz		0.050	0.051	+0.001	1.5
0.01	50 Hz	peak	0.010	0.011	+0.001	8.9
0.02	50 Hz		0.020	0.021	+0.001	4.9
0.03	50 Hz		0.030	0.031	+0.001	3.1
0.04	50 Hz		0.040	0.041	+0.001	2.4
0.05	50 Hz		0.050	0.051	+0.001	2.0

Note: * means Calibrations marked " Not JIS Accredited " in this Certificate have been included for completeness

This report is valid for the above stated instrument's only.

End of Certificate 0/0

Certificate No. Q19021060

F3-011-04-01-12

เอกสารใบกำกับ
Page 2 of 4



FOR

7-10 (2010)
7-11 (2010)



FOR

CONFIDENTIAL

[illegible]

MEASUREMENT RESULTS: (X) without adjustment () adjustment

1. ACCELERATION RESULTS

2. VELOCITY RESULT

1-3-011-0401-12[illegible][illegible]

2. DISACRYL

10.1111/j.1365-3113.2011.04511.x
 © 2011 The Authors
 Journal compilation © 2011 British
 Ecological Society,
*Journal of Animal
 Ecology*, **80**,
 1005–1014

Note: * means Calibrations marked "N of 1HS Accredited" in the Certificate have been included for completeness

End Certificate for Page 11 of 11

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QUALITY CALIBRATION CO.,LTD.

235 Pothkasem 63/2 Road, Laksoeng, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

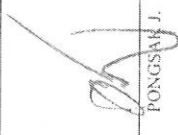
www.qcalibration.com

CERTIFICATE No : 19E6565
REFERENCE No : 57287-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : 6236
SERIAL No : 172086
ID No : UAE.EFM.0872560
SUBMITTED BY : UNITED ANALYST AND ENGINEERING
CONSULTANT CO., LTD.
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK, PHRAKHANONG, BANGKOK
10260

CALIBRATED BY : CHAICHARN CH.
CALIBRATION DATE : 11-Jul-19
APPROVED BY : 
PONGSAK J.
ISSUED DATE : 11-Jul-19
RECEIVED DATE : 09-Jul-19

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.
1-5016 REV.02

เอกสารรับรองการสอบเทียบ



QUALITY CALIBRATION CO.,LTD.

235 Pothkasem 63/2 Road, Laksoeng, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 19E6565

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : 6236
S/N : 172086
ID No : UAE.EFM.0872560
RECEIVED DATE : 09-Jul-19
CALIBRATION DATE : 11-Jul-19
AMBIENT TEMPERATURE : 23°C ± 3°C
RELATIVE HUMIDITY : 50 % RH ± 20 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2:2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR.
THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR AT 94 Hz BEFORE CALIBRATION.

2. REFERENCE STANDARD INSTRUMENTS :

INSTRUMENT MODEL SERIAL No CERTIFICATE No DUE DATE
1) MULTIFUNCTION 1986 01285 19E0445 08-Feb-20
SOUND CALIBRATOR

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

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

5. THIS CERTIFICATE IS TRACEABLE TO :
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAI AND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (ISTR).

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
125.00	-16.10	-15.6	-0.5	0.50
250.00	-8.60	-8.3	-0.3	0.50
500.00	-3.20	-3.0	-0.2	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	1.20	1.0	0.2	0.50
4000.00	1.00	-0.1	1.1	0.50

2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
125.00	-0.20	0.1	-0.3	0.50
250.00	0.00	0.2	-0.2	0.50
500.00	0.00	0.2	-0.2	0.50
1000.00	0.00	0.1	-0.1	0.50
2000.00	-0.20	-0.3	0.1	0.50
4000.00	-0.80	-1.8	1.0	0.50

3. SOUND LEVEL LINEARITY TEST AT 1000 Hz

STANDARD APPLIED (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
74	74.0	0.0	0.50
84	84.0	0.0	0.50
94	94.0	0.0	0.50
104	104.1	-0.1	0.50
114	114.2	-0.2	0.50

UUC* : UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

เอกสารรับรองการสอบเทียบ

1-5016 REV.02




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

CERTIFICATE No : 19E6504
REFERENCE No : 55268-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : 6236
SERIAL No : 172085
ID No : UAE.EFM.086/2560
SUBMITTED BY : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK, PHRAKHANONG, BANGKOK
10360

CALIBRATED BY : CHAICHARN CHIL
CALIBRATION DATE : 09-Jul-19
APPROVED BY : 
PONGSAK J.
ISSUED DATE : 09-Jul-19
RECEIVED DATE : 08-Jul-19

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.
1-000 REV 02



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

CERTIFICATE No : 19E6504

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : 6236
SN : 172085
ID No : UAE.EFM.086/2560
RECEIVED DATE : 08-Jul-19
CALIBRATION DATE : 09-Jul-19
AMBIENT TEMPERATURE : 23°C ± 3°C
RELATIVE HUMIDITY : 50% RH ± 20% RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2 2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR
2. THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR AT 94 Hz BEFORE CALIBRATION
3. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT : MODEL : 1986
SOUND CALIBRATOR : SERIAL No : 01385
CERTIFICATE No : 19E0445
DUE DATE : 08-Feb-20

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

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

6. THIS CERTIFICATE IS TRACEABLE TO :-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR).

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
125.00	-16.10	-16.3	0.2	0.50
250.00	-8.60	-8.7	0.1	0.50
500.00	-3.20	-3.2	0.0	0.50
1000.00	0.00	-0.1	0.1	0.50
2000.00	1.20	1.0	0.2	0.50
4000.00	1.00	0.2	0.8	0.50

2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
125.00	-0.70	-0.4	0.2	0.50
250.00	0.00	0.0	0.0	0.50
500.00	0.00	0.0	0.0	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	-0.20	-0.3	0.1	0.50
4000.00	-0.80	-1.5	0.7	0.50

3. SOUND LEVEL LINEARITY TEST AT 1000 Hz

STANDARD APPLIED (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (± dB)
74	73.9	0.1	0.50
84	83.8	0.2	0.50
94	94.0	0.0	0.50
104	104.0	0.0	0.50
114	114.0	0.0	0.50

UUC :- UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

1-000 REV 02




Calibration Certificate

Certificate No.: 2000972-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Page 1 of 5

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: AB204-S
Serial No.: 1128312528
ID No.: UAE LAB.019/2550
Order No.: 2000972
Operation No.: 2000972-001
Date of Receipt: 25 December 2019
Date of Calibration: 25 December 2019

Calibrated by Mr. Manas Somsak
Senior Analyst
Approved by 
(Mr. Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team
Date of Issue: 27 December 2019

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

FCS-009 Revision: 03 Date: 14-12-61

เอกสารไม่ควบคุม



Calibration Report

Certificate No.: 2000972-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: AB204-S
Resolution: 0.0001 g
Serial No.: 1128312528
ID No.: UAE LAB.019/2550
Capacity: 220 g

Page 2 of 5

Date of Calibration: 25 December 2019
Environment Condition: Ambient Temperature: 23.9 ± 0.2 °C Relative Humidity: 51 ± 3 %
Place of Calibration: 306 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NIST Method WMA-200 In-House Method Based on UKAS LAB 14 Calibration of Weighing Machines, 2006

2. Reference Standards

Reference Standard Model Serial No. Calibrated By Certificate No. Due Date
Standard Weight Class E2 1mg to 200g B50559752 TCS H1504595 6 April 2020

Instrument Model Serial No. Calibrated By Certificate No. Due Date
Thermo-Hygro Meter 1141 eaw RH BTH 001.55 Qualix Return 04/19/1416 19 August 2020

3. This certificate is traceable to SI UNIT

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

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

Calibration Results:

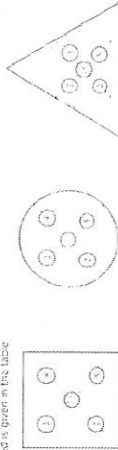
1. Repeatability of Reading:

2. Off-Center Error:

A mass of 50 g was placed and moved to various positions on pan

The balance reading obtained is given in the table

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.00042
200	0.00042



1	2	3	4	5	6	(Maximum Difference)
(g)	(g)	(g)	(g)	(g)	(g)	(g)
50.0000	49.9999	49.9999	50.0000	50.0000	50.0000	0.0001

FCS-012 Revision: 03 Date: 14-12-61

เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2000972-001-01
Equipment: Electronic Balance
Model: AB204-S
Serial No.: 1128312528
Capacity: 220 g

Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE/LAB/019/2550

Date of Calibration: 25 December 2019 Page 3 of 5

Calibration Results: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (g)	Coverage Factor
Unread	0.0000	0.0000	0.0000	0.000386	2.00
0.1	0.1000	0.1000	0.0000	0.000387	2.00
0.5	0.5000	0.5000	0.0000	0.000387	2.00
1.0	1.0000	1.0000	0.0000	0.000387	2.00
5	5.0000	5.0000	0.0000	0.000386	2.00
10	10.0000	10.0000	0.0000	0.000386	2.00
20	20.0000	20.0000	0.0000	0.000386	2.00
50	50.0000	50.0000	0.0000	0.000386	2.00
70	70.0000	70.0000	0.0000	0.000386	2.00
100	100.0000	100.0000	0.0000	0.000386	2.00
150	150.0000	150.0000	0.0000	0.000386	2.00
200	200.0000	200.0000	0.0000	0.000386	2.00

Calibration Report

Certificate No.: 2000972-001-01
Equipment: Electronic Balance
Model: AB204-S
Serial No.: 1128312528
Capacity: 220 g

Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE/LAB/019/2550

Date of Calibration: 25 December 2019 Page 4 of 5

Environment Condition: Ambient Temperature: 23.9 °C Relative Humidity: 51 %

Place of Calibration: 306 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-94A-301 In-House Method Based on UKAS LAB 14 Calibration of Weighing Machines, 2006

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	8505567572	TCS	H1900395	6 April 2020
Thermo-Hygro Meter	11A1	854161 BTH 00255	Quality Report	QR19-1416	19 August 2020

3. This certification is traceable to SI UNIT

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

5. The result of calibration was found accurate as shown on date and scale of calibration only.

Calibration Results: (Test Weight by P for 100g)

1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
10	0.000042
20	0.000042

2. Off-Center Error:

A mass of 5 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.

1	2	3	4	5	6	(Maximum Difference)
(g)	(g)	(g)	(g)	(g)	(g)	(g)
5.0000	5.0001	5.0000	5.0000	5.0001	5.0000	0.0001



NSC 15115 17025
CALIBRATION 0063

Calibration Certificate ID
TH2027-047-052819-ACC-TH

Mettler-Toledo (Thailand) Limited
272 Soi Srinakharinwirot 4, Bangkok
Pudungwong Bangkok 10310
THAILAND
www.mt.com

Accuracy Calibration Certificate

Customer

Company: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Jitomsak 41, Sathornwit Road, Bangkok
City: Phraekhanong
Zip / Postal: 10260
State / Province: BANGKOK
Order Number: 11000000000000000000

Contact: Mr. Suwit Chonrak

Weighing Device

Manufacturer: Mettler Toledo
Model: AB204-SFACT
Serial No.: B108115658
Building: N/A
Floor: N/A
Room: Balance Room

Instrument Type: Weighing Instrument
Asset Number: UAE LAB 016/2555
Terminal Model: N/A
Terminal Serial No.: N/A
Terminal Asset No.: N/A

Range	Max Capacity	Readability (g)
1	220 g	0.0001 g

Procedure

Calibration Guideline:
METTLER TOLEDO Work Instruction:

EURAMET cg 18 v 4.0 (1/2015)
CIPM00316

This calibration certificate contains measurements for As Found and As Left calibrations.

The sensitivity span of the weighing instrument was adjusted before As Found and As Left calibrations with a built-in weight.

	As Found	Start	End	Start	End
Temperature	22.7 °C	22.8 °C	22.8 °C	43.3 °C	44.1 °C
Humidity	Start 22.8 °C	End 22.8 °C	Start 44.2 °C	End 44.5 °C	

As Found Calibration Date: 28-May-2019
As Left Calibration Date: 28-May-2019
Issue Date: 3 Jun 2019

Calibration:

Approved Signatory:

Signature: Stijnt Huisshof

☒ Soriti Janyan
☐ Sorati et Sukkate

Calibration Report

Certificate No.: 2060972-001-01

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: AB204-S
Resolution: 0.0001 g
Serial No.: 1128312538
ID No.: UAE LAB 019/2550
Capacity: 220 g

Date of Calibration: 25 December 2019

Calibration Results: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Test weight by filter pan)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (g)	Coverage Factor (k)
Unload	0.0000	0.0000	0.0000	0.000085	2.00
0.01	0.0100	0.0100	0.0000	0.000085	2.00
0.05	0.05000	0.0500	0.0000	0.000086	2.00
0.1	0.10001	0.1000	0.0000	0.000087	2.00
0.5	0.50001	0.5000	0.0000	0.000087	2.00
1	1.00001	1.0000	0.0000	0.000087	2.00
2	2.00002	2.0000	0.0000	0.000087	2.00
3	3.00003	3.0000	0.0000	0.000088	2.00
4	4.00004	4.0000	0.0000	0.000088	2.00
5	5.00002	5.0000	0.0000	0.000088	2.00
10	10.00002	10.0000	0.0000	0.000090	2.00
15	15.00003	15.0000	0.0000	0.000092	2.00
20	20.00004	20.0000	0.0000	0.000095	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%.

Measurement Results

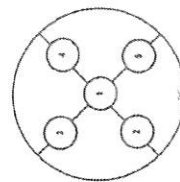
Repeatability

Test Load: 100 g			
Position	As Found	As Left	As Found
1	100.0002 g	100.0001 g	As Found
2	100.0002 g	100.0000 g	As Left
3	100.0002 g	100.0001 g	As Found
4	100.0002 g	100.0001 g	As Left
5	100.0002 g	100.0000 g	As Found
6	100.0003 g	100.0000 g	As Left
7	100.0003 g	100.0000 g	As Found
8	100.0002 g	100.0001 g	As Left
9	100.0003 g	100.0001 g	As Found
10	100.0001 g	100.0000 g	As Left
Standard Deviation	0.00006 g	0.00005 g	

The "g" in the graph represents the repeatability of the experiment in which the test was performed.
The results of this graph are listed against the Absolute values of the difference from the mean value.

Eccentricity

Test Load: 100 g			
Position	As Found	As Left	As Found
1	100.0002 g	100.0000 g	As Found
2	100.0002 g	99.9999 g	As Left
3	100.0002 g	100.0000 g	As Found
4	100.0003 g	100.0000 g	As Left
5	100.0004 g	100.0002 g	As Found
Maximum Deviation	0.00002 g	0.00002 g	



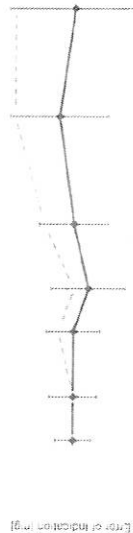
Error of Indication

Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.14 mg	2
2	0.1000 g	0.0000 g	0.15 mg	2
3	1.0000 g	0.0000 g	0.15 mg	2
4	5.0000 g	0.0000 g	0.16 mg	2
5	10.0000 g	0.0000 g	0.16 mg	2
6	20.0000 g	0.0000 g	0.17 mg	2
7	50.0000 g	0.0001 g	0.20 mg	2
8	70.0000 g	0.0000 g	0.20 mg	2
9	100.0000 g	0.0002 g	0.24 mg	2
10	150.0000 g	0.0004 g	0.34 mg	2
11	200.0000 g	0.0004 g	0.44 mg	2

Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.12 mg	2
2	0.1000 g	0.0000 g	0.13 mg	2
3	1.0000 g	0.0000 g	0.14 mg	2
4	5.0000 g	0.0000 g	0.14 mg	2
5	10.0000 g	0.0000 g	0.15 mg	2
6	20.0000 g	0.0000 g	0.16 mg	2
7	50.0000 g	0.0000 g	0.18 mg	2
8	70.0000 g	0.0001 g	0.20 mg	2
9	100.0000 g	0.0000 g	0.23 mg	2
10	150.0000 g	0.0001 g	0.30 mg	2
11	200.0000 g	0.0000 g	0.44 mg	2

As Found

As Left



For improved legibility of the graphs, only the calibration measurement points are shown, and intermediate points (1 mg to 10 mg) are not displayed.

Calibration Points [g]

The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor $k = 2$ which can be larger than 2 according to EURAMET CG-13. The value of the measure and less within the assigned range of values with a probability of approximately 95%.

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

Test Equipment

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

Weight Set 1: OIML E2

Weight Set No.: WS38
Certificate Number: 157160
Date of Issue: 09-Aug-2019
Calibration Due Date: 01-May-2020

Thermo Hygrometer

Equipment No.: IN160
Certificate Number: 199143
Date of Issue: 13-Feb-2019
Calibration Due Date: 01-Jan-2020

Remarks

Equipment condition: Good

Next calibration according to customer's procedure

Test weight by filter pan: 1g = 1.0000g, 3g = 3.0001g, 5g = 5.0000g.

End of Accredited Section

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

Measurement Uncertainty of the Weighing Instrument in Use

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

Temperature coefficient for the evaluation of the measurement uncertainty in use: $2.5 \cdot 10^{-7} \text{ K}$

Test parameter range in use for the evaluation of the measurement uncertainty in use: 5 g

Uncertainty of Uncertainty Equation

Range	As Found	As Left
0 g - 220 g	$U_1 = 0.15 \text{ mg} + 0.0121 \text{ mg/g} \cdot R$	$U_1 = 0.13 \text{ mg} + 0.00916 \text{ mg/g} \cdot R$

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

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

Net Indication	As Found	As Left
0.0220 g	0.15 mg	0.13 mg
0.2200 g	0.15 mg	0.088%
2.2000 g	0.15 mg	0.0082%
22.0000 g	0.42 mg	0.0019%
220.0000 g	2.8 mg	0.0013%
		0.59%
		0.050%
		0.0069%
		0.0015%
		0.00098%

