



บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด

TOPS-LAB Consultants CO., LTD.

189 หมู่ที่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110

189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

TSP High Volume Sampler Calibration

Calibration Report No. TSP-6607017

TSP No.: 1947

Date: 18-Jul-23

Location: บริเวณพื้นที่โครงการ

Technical: B.Manipa

Approval: K.Metawee

CONDITIONS

Sea Level Pressure (hPa):	1004.0	Corrected Pressure (mm Hg):	753.1
Temperature (deg C):	31.0	Temperature (deg K):	304.0
Seasonal SL Press. (hPa):	1000.7	Corrected Seasonal (mm Hg):	750.6
Seasonal Temp. (deg C):	20.0	Seasonal Temp. (deg K):	293.0

CALIBRATION ORIFICE

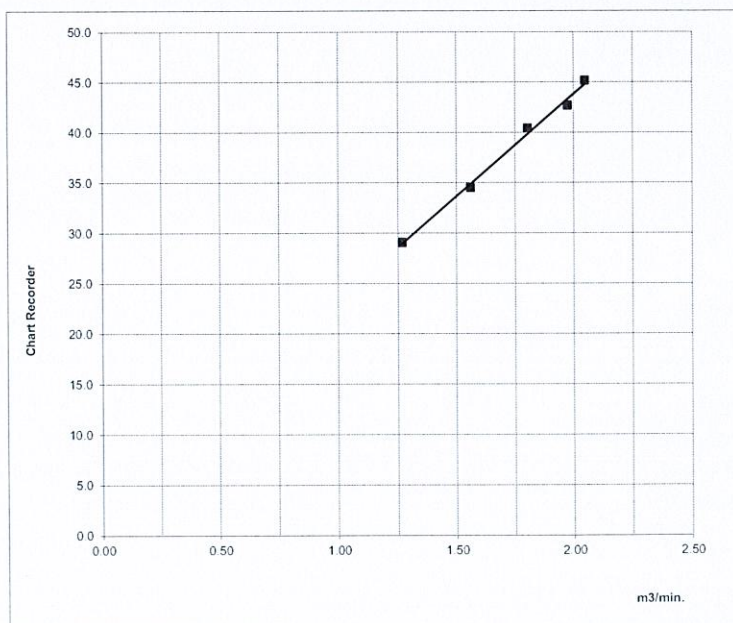
Make: Tisch Environmental, Inc
Model: TE-5025A
Serial#: 3092

Qstd Slope: 1.29243
Qstd Intercept: -0.01962
Date Certified: 20-Jun-23

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	2.70	1.268	29.50	29.07	Slope = 20.3473
2	4.10	1.559	35.00	34.49	Intercept = 3.1476
3	5.50	1.804	41.00	40.41	Corr. coeff.= 0.9970
4	6.60	1.974	43.30	42.67	
5	7.10	2.047	45.80	45.14	# of Observations: 5

Range of Chart
at 40-60 CFM 53.30



Calibrated by

Approved by

**บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด**

TOPS-LAB Consultants CO., LTD.

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189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

PM10 High Volume Sampler VerificationVerification Report No. PM-6607017**SITE**

PM-10 No.: 1947

Date: 18-Jul-23Location: บริเวณพื้นที่โครงการTest: B.ManipaApproval: K.Metawee**CONDITIONS**

Sea Level Pressure (hPa):	<u>1004.0</u>	Corrected Pressure (mm Hg):	<u>753.1</u>
Temperature (deg C):	<u>31.0</u>	Temperature (deg K):	<u>304.0</u>
Seasonal SL Press. (hPa):	<u>1005.8</u>	Corrected Seasonal (mm Hg):	<u>754.4</u>
Seasonal Temp. (deg C):	<u>21.0</u>	Seasonal Temp. (deg K):	<u>294.0</u>

CALIBRATION ORIFICE

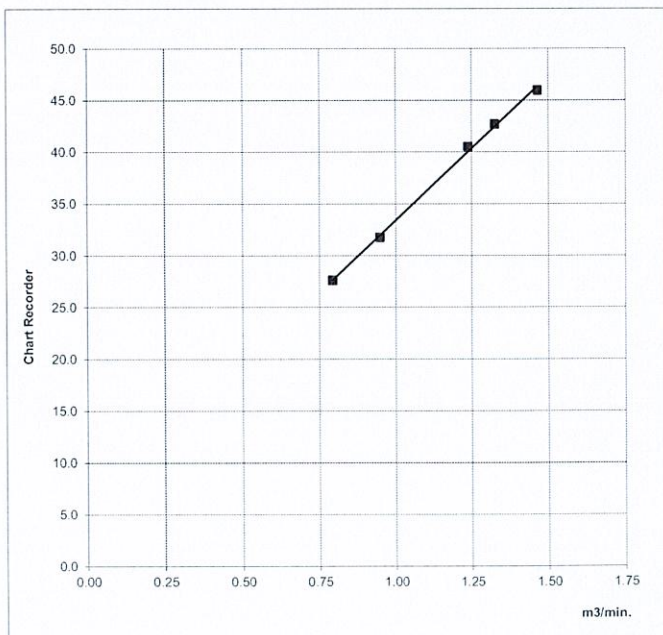
Make: Tisch Environmental, Inc
Model: TE-5025A
Serial#: 3092

Slope: 1.29243
Intercept: -0.01962
Date Certified: 20-Jun-23

TEST

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	<u>2.50</u>	<u>0.792</u>	<u>28.00</u>	<u>27.60</u>	Slope (m)= <u>27.8346</u>
2	<u>3.60</u>	<u>0.948</u>	<u>32.20</u>	<u>31.73</u>	Intercept (b)= <u>5.5666</u>
3	<u>6.20</u>	<u>1.239</u>	<u>41.10</u>	<u>40.51</u>	Corr. coeff.(r)= <u>0.9990</u>
4	<u>7.10</u>	<u>1.325</u>	<u>43.30</u>	<u>42.67</u>	SFR = <u>1.171</u>
5	<u>8.70</u>	<u>1.465</u>	<u>46.60</u>	<u>45.93</u>	SSP = <u>60.04</u>
					# of Observations: <u>5</u>

Range of Chart
at 36-44 CFM 39.50



Test by

Approved by :



บริษัท ทีโอพีส์-แลบ คอนซัลแตนท์ จำกัด

TOPS-LAB Consultants CO., LTD.

189 หมู่ที่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110

189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

Verification Test Report

Report No. : SLM-6607014

Calibrated Date : July 18, 2023

Equipment : Sound Level Meter

Manufacturer : ACO

Model : 6226

Serial or ID No. 64355

Reference Standard : Sound Calibrator Model QC-10

Serial No. QIK100282

Date of Calibration : February 22, 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
114.0	114.1	0.1	114.0

Calibrated By : _____

Date : _____

Approve By : _____

Date : _____

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หมู่ที่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110 189

Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110 189

Tel : (662) 159-0121 Fax : (662) 159-0122

Analyzer Performance Test

Calibration Report No.: 6607014

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Calibrated Date: 18 July 2023

Calibrated For: บริษัท เอสพีเอส ภูเก็ต คอนสตรัคชั่น จำกัด

Instruments Information

Analyzer Type: CO Analyzer Model: TML-30	Manufacturer API S/N: 2340
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Calibration System

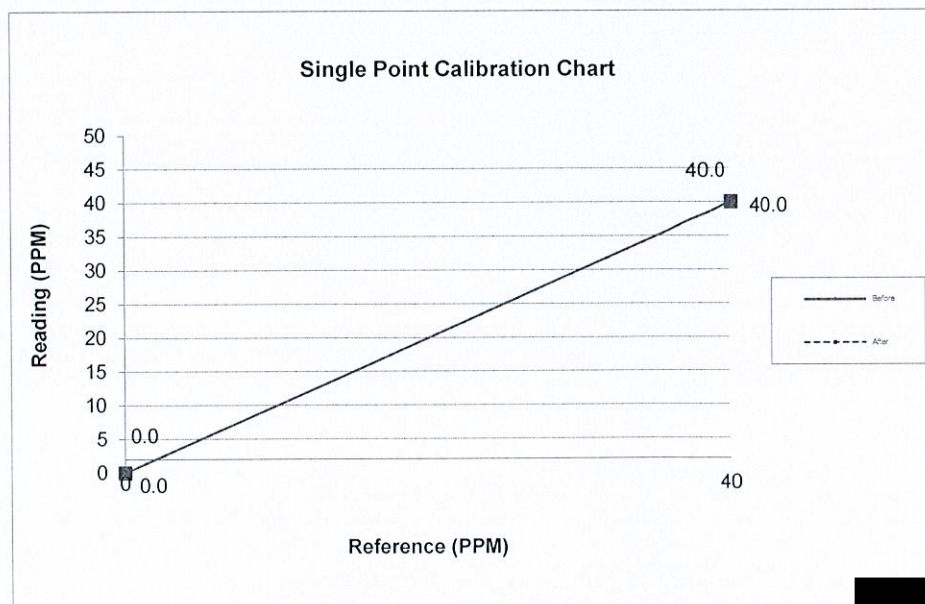
Calibrator Unit	Standard Gas
Dilutor Model Thermo Electron Model 5008 S/N: 146-17299-169 ZERO AIR Generator E07NI99E15A0002 S/N: EB0125123	NO Conc 54.81 PPM SO2 Conc 52.99 PPM CO Conc 4,469 PPM Expire Date: 6 November 2027

Environment: Temperature 31.0 °C

Humidity: 47.0 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.0	0.0	40.0	40.0	0.0
After	0.0	0.0	0.0	40.0	40.0	0.0



Calibrate By :

Approve By :

**บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด**

TOPS-LAB Consultants CO., LTD.

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189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

TSP High Volume Sampler Calibration**Calibration Report No. TSP-6608016**

TSP No.: 1946

Date: 26-Aug-23

Location: บริเวณพื้นที่โครงการ

Technical: B.Manipa

Approval: K.Metawee

CONDITIONS

Sea Level Pressure (hPa):	1006.0	Corrected Pressure (mm Hg):	754.6
Temperature (deg C):	33.0	Temperature (deg K):	306.0
Seasonal SL Press. (hPa):	1000.7	Corrected Seasonal (mm Hg):	750.6
Seasonal Temp. (deg C):	20.0	Seasonal Temp. (deg K):	293.0

CALIBRATION ORIFICE

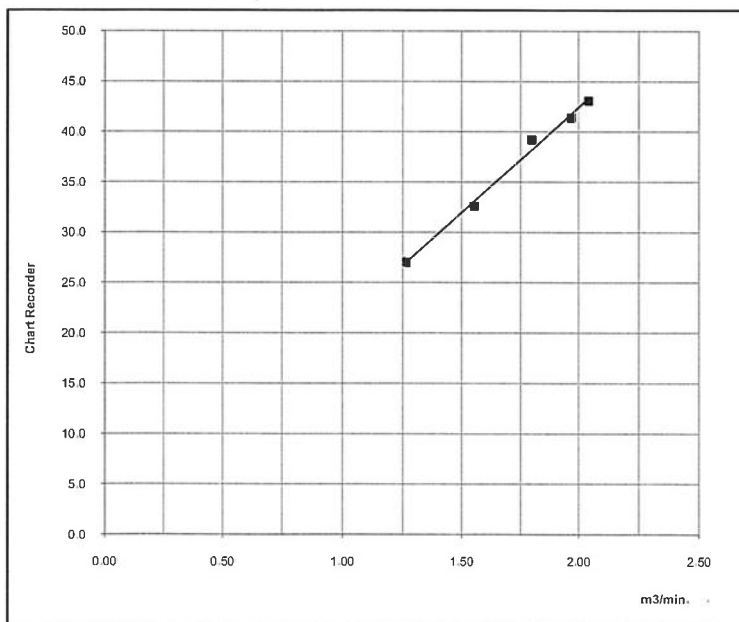
Make: Tisch Environmental, Inc
Model: TE-5025A
Serial#: 3092

Qstd Slope: 1.29243
Qstd Intercept: -0.01962
Date Certified: 20-Jun-23

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	2.70	1.265	27.50	27.04	Slope = 20.8946
2	4.10	1.556	33.20	32.65	Intercept = 0.6019
3	5.50	1.799	39.90	39.23	Corr. coeff.= 0.9959
4	6.60	1.970	42.10	41.40	
5	7.10	2.042	43.80	43.07	# of Observations: 5

Range of Chart
at 40-60 CFM 48.60



Calibrated by :

Approved by :

**บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด**

TOPS-LAB Consultants CO., LTD.

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189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

PM10 High Volume Sampler Verification

Verification Report No. PM-6608016

SITE

PM-10 No.: 5095

Date: 26-Aug-23

Location: บริเวณพื้นที่โครงการ

Test: B.Manipa

Approval: K.Metawee

CONDITIONS

Sea Level Pressure (hPa): 1006.0

Corrected Pressure (mm Hg): 754.6

Temperature (deg C): 33.0

Temperature (deg K): 306.0

Seasonal SL Press. (hPa): 1005.8

Corrected Seasonal (mm Hg): 754.4

Seasonal Temp. (deg C): 21.0

Seasonal Temp. (deg K): 294.0

CALIBRATION ORIFICE

Make: Tisch Environmental, Inc

Slope: 1.29243

Model: TE-5025A

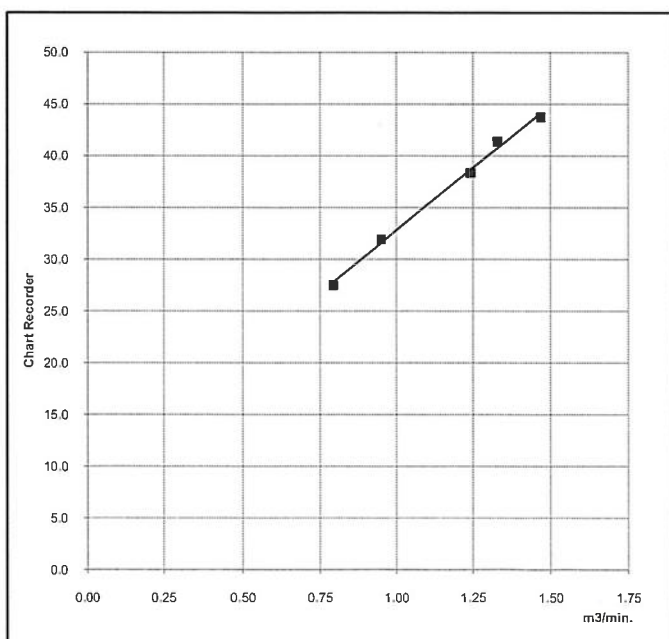
Intercept: -0.01962

Serial#: 3092

Date Certified: 20-Jun-23

TEST

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	2.50	0.794	28.00	27.53	Slope (m)= 24.1882
2	3.60	0.950	32.50	31.96	Intercept (b)= 8.6226
3	6.20	1.242	39.00	38.35	Corr. coeff. (r)= 0.9975
4	7.10	1.328	42.10	41.40	SFR = 1.176
5	8.70	1.469	44.50	43.76	SSP = 58.20
					# of Observations: 5

Range of Chart
at 36-44 CFM 43.10

Test by :

Approved by :



บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด

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189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

Analyzer Performance Test

Calibration Report No.: 6608014

Page:1/1

Calibrated Date: 26 August 2023

Calibrated For: บริษัท เอสพีเอส ภูเก็ต คอนสตรัคชั่น จำกัด

Instruments Information

Analyzer Type: CO Analyzer Model: TML-30	Manufacturer API S/N: 2340
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Calibration System

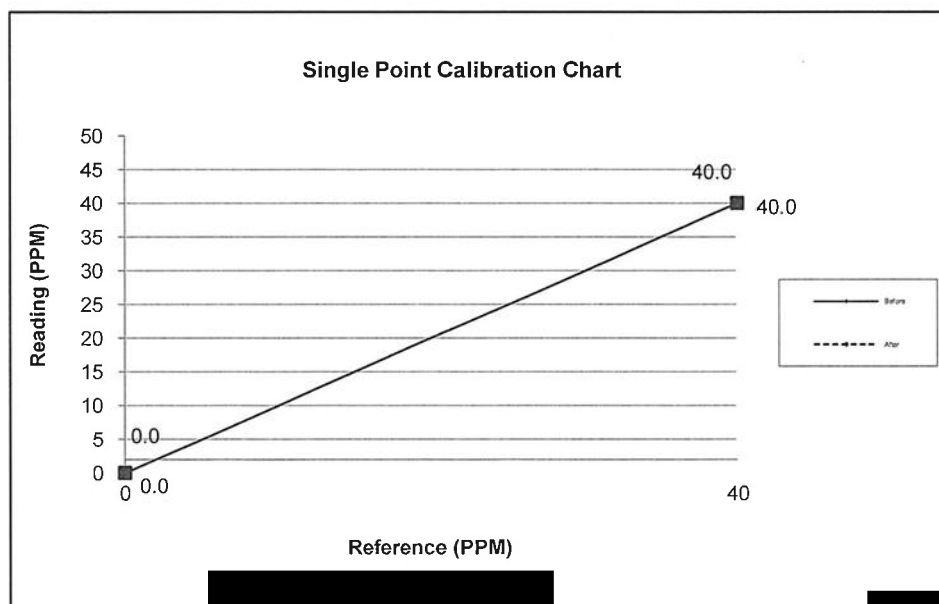
Calibrator Unit	Standard Gas
Dilutor Model Thermo Electron Model 5008 S/N: 146-17299-169 ZERO AIR Generator E07NI99E15A0002 S/N: EB0125123	NO Conc 54.81 PPM SO ₂ Conc 52.99 PPM CO Conc 4,469 PPM Expire Date: 6 November 2027

Environment: Temperature 33.0 °C

Humidity: 47.0 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.0	0.0	40.0	40.0	0.0
After	0.0	0.0	0.0	40.0	40.0	0.0



Calibrate By : _____

Approve By : _____

**บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด**

TOPS-LAB Consultants CO., LTD.

189 หมู่ที่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110

189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

Verification Test Report**Report No. : SLM-6608018****Calibrated Date : August 26, 2023****Equipment : Sound Level Meter****Manufacturer : ACO****Model : 6226****Serial or ID No. 64355****Reference Standard : Sound Calibrator Model QC-10**

Serial No. QIK100282

Date of Calibration : February 22, 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
114.0	114.1	0.1	114.0

Calibrated By : _____

Date : _____

Approve By : _____

Date : _____

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189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

TSP High Volume Sampler CalibrationCalibration Report No. TSP-6609021

TSP No.: 1946

Date: 19-Sep-23

Location: บริเวณพื้นที่โครงการTechnical: B.ManipaApproval: K.Metawee**CONDITIONS**

Sea Level Pressure (hPa):	<u>1009.0</u>	Corrected Pressure (mm Hg):	756.8
Temperature (deg C):	<u>33.0</u>	Temperature (deg K):	306.0
Seasonal SL Press. (hPa):	<u>1000.7</u>	Corrected Seasonal (mm Hg):	750.6
Seasonal Temp. (deg C):	<u>20.0</u>	Seasonal Temp. (deg K):	293.0

CALIBRATION ORIFICE

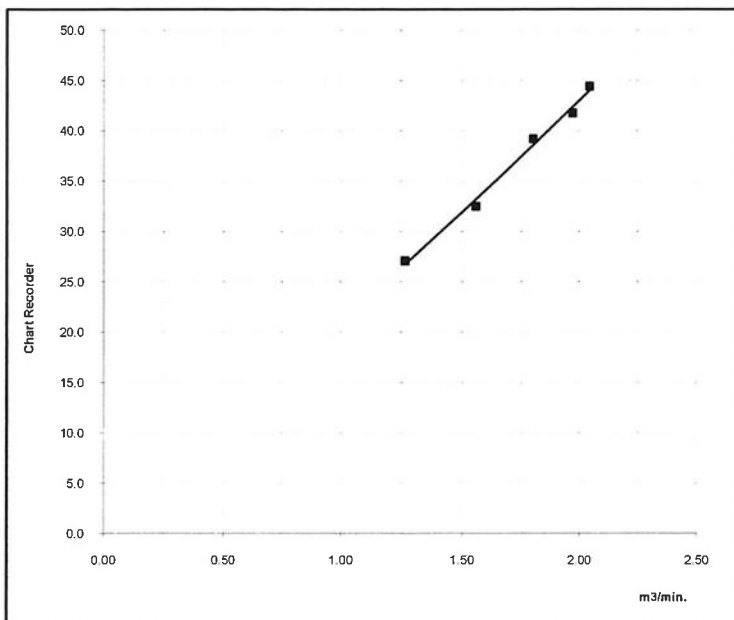
Make: Tisch Environmental, Inc
Model: TE-5025A
Serial#: 3092

Qstd Slope: 1.29243
Qstd Intercept: -0.01962
Date Certified: 20-Jun-23

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	<u>2.70</u>	1.267	<u>27.50</u>	27.08	Slope = 22.1305
2	<u>4.10</u>	1.558	<u>33.00</u>	32.50	Intercept = -1.2777
3	<u>5.50</u>	1.802	<u>39.80</u>	39.19	Corr. coeff.= 0.9962
4	<u>6.60</u>	1.973	<u>42.40</u>	41.75	
5	<u>7.10</u>	2.045	<u>45.10</u>	44.41	# of Observations: 5

Range of Chart
at 40-60 CFM 48.70



Calibrated by

Approved by :



บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด

TOPS-LAB Consultants CO., LTD.

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189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

PM10 High Volume Sampler Verification

Verification Report No. PM-6609021

SITE

PM-10 No.: 1946

Date: 19-Sep-23

Location: บริเวณพื้นที่โครงการ

Test: B.Manipa

Approval: K.Metawee

CONDITIONS

Sea Level Pressure (hPa):	1009.0	Corrected Pressure (mm Hg):	756.8
Temperature (deg C):	33.0	Temperature (deg K):	306.0
Seasonal SL Press. (hPa):	1005.8	Corrected Seasonal (mm Hg):	754.4
Seasonal Temp. (deg C):	21.0	Seasonal Temp. (deg K):	294.0

CALIBRATION ORIFICE

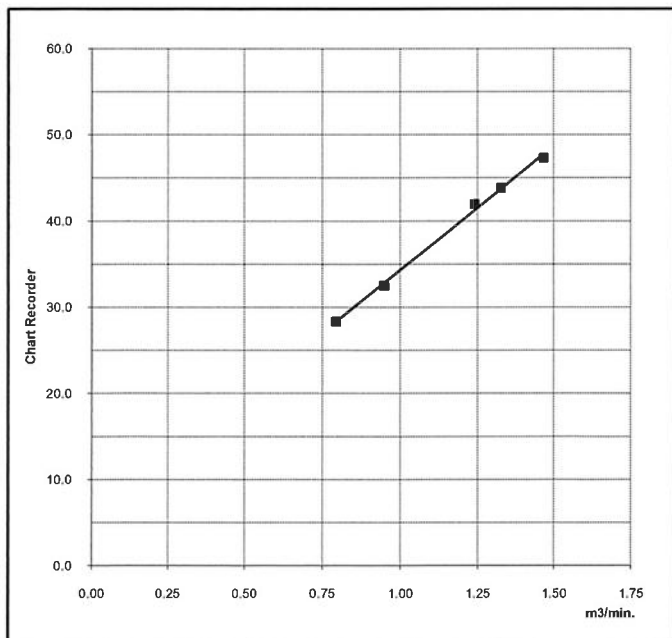
Make: Tisch Environmental, Inc
Model: TE-5025A
Serial#: 3092

Slope: 1.29243
Intercept: -0.01962
Date Certified: 20-Jun-23

TEST

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	2.50	0.793	28.80	28.36	Slope (m)= 28.8325
2	3.60	0.949	33.00	32.50	Intercept (b)= 5.4879
3	6.20	1.240	42.60	41.95	Corr. coeff.(r)= 0.9984
4	7.10	1.326	44.50	43.82	SFR = 1.172
5	8.70	1.466	46.70	47.30	SSP = 61.79
				0.00	# of Observations: 5

Range of Chart
at 36-44 CFM 41.30



Test by

Approved by :

**บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด**

TOPS-LAB Consultants CO., LTD.

189 หมู่ที่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110

189 Moo. 3 Bangrakphatthana Bangbuthong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

Analyzer Performance Test

Calibration Report No.: 6609015

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Calibrated Date: 19 September 2023

Calibrated For: บริษัท เอสพีเอส ภูเก็ต คอนสตรัคชั่น จำกัด

Instruments Information

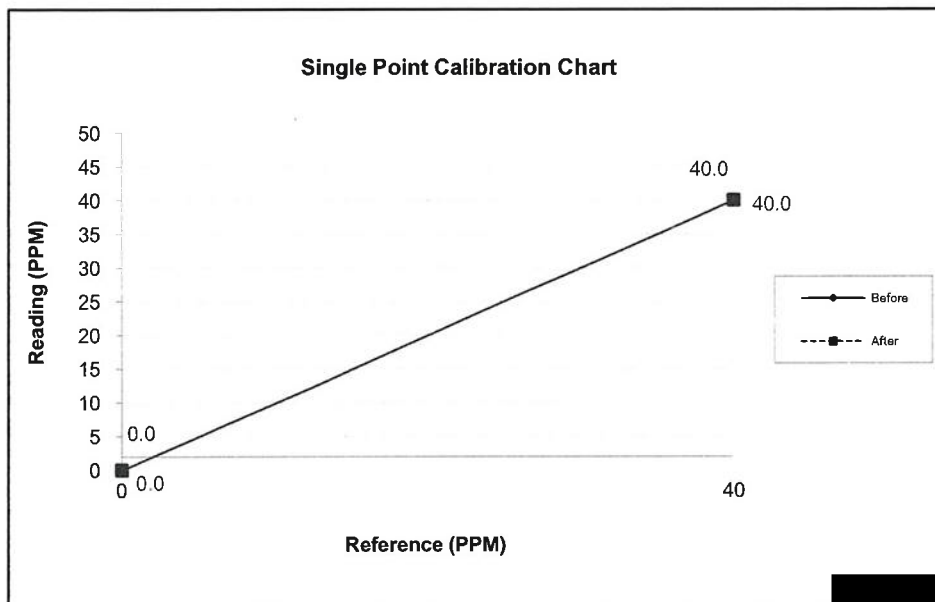
Analyzer Type: CO Analyzer Model: TML-30	Manufacturer Thermo S/N: 2340
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Thermo Electron Model 5008 S/N: 146-17299-169 ZERO AIR Generator E07NI99E15A0002 S/N: EB0125123	NO Conc 54.81 PPM SO2 Conc 52.99 PPM CO Conc 4,469 PPM Expire Date: 6 November 2027

Environment: Temperature 33.0 °CHumidity: 47.0 %RH**Calibration Report**

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.0	0.0	40.0	40.0	0.0
After	0.0	0.0	0.0	40.0	40.0	0.0



Calibrate By : _____

Approve By : _____



บริษัท ท็อปส์-แลบ คอนซัลแตนท์ จำกัด

TOPS-LAB Consultants CO., LTD.

189 หมู่ที่ 3 ตำบลบางรักพัฒนา อำเภอบางบัวทอง จังหวัดนนทบุรี 11110

189 Moo. 3 Bangrakphatthana Bangbuathong Nonthaburi 11110

Tel : (662) 159-0121 Fax : (662) 159-0122

Verification Test Report

Report No. : SLM-6609022

Calibrated Date : September 19, 2023

Equipment : Sound Level Meter

Manufacturer : ACO

Model : 6226

Serial or ID No. 64355

Reference Standard : Sound Calibrator Model QC-10

Serial No. QIK100282

Date of Calibration : February 22, 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
114.0	114.1	0.1	114.0

Calibrated By : _____

Date : _____

Approve By : _____

Date : _____



National Institute of Metrology (Thailand)
Ministry of Higher Education, Science, Research and Innovation

Certificate of Calibration

Certificate No. : MW-0037-23
Issued by : Flow and Volume of Liquid Laboratory
Mechanical Metrology Department

Page 1 of 3 pages

MEASUREMENT ITEM : Orifice Gas Flow Device

MANUFACTURER : Tisch Environmental, Inc.

MODEL/TYPE : TE-5025A

SERIAL NUMBER : 3092

CUSTOMER : TOPS-LAB Consultants Co.,Ltd
189 Moo 3 Bangrakphatthana Bangbuathong
Nonthaburi 11110 Thailand

MEASUREMENT DATE : June 21, 2023

The reported measurement result relates only to the measurand and applies only at the time of measurement.

Reference:
MEC8646-01/23

Date:
June 27, 2023

(Wirun Laopornpichayanuwat)

Performed by:

Partial reproduction of this certificate is permitted only with a written permission from NIMT.



ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows :

Temperature	: 23.0 ± 2.0	°C
Relative Humidity	: 55 ± 15	%RH

Calibration Condition:

Preconditioning	: 24 hours at ambient conditions.
Measurement Condition	: The average values during measurement are 23.9°C and 61 %RH.

MEASUREMENT METHOD:

The Orifice gas flow device was calibrated against NIMT's Standard Gas Meter Model DELTA S-Flow G65. The CP-MW 0009 was used as a calibration guideline.

TABULATION OF RESULTS:

The tables on the next page give the measured values.

UNCERTAINTY OF MEASUREMENT:

The stated uncertainty is the expanded uncertainty which is obtained by multiplying the standard uncertainty by the coverage factor $k = 2$. It has been determined in accordance with EA publication EA-4/02M:2013 "Evaluation of the Uncertainty of Measurement in Calibration" and "JCGM 100:2008 Evaluation of measurement data - Guide to the Expression of Uncertainty in Measurement (GUM 1995 with minor corrections)". The value of the measurand lies within the assigned range of values with a probability of 95 %.

TRACEABILITY:

This certificate provides a traceability of the measurement to recognized the national standards, and to the realization of the International System of Units (SI).

MEASUREMENT RESULTS:

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

Table 1. The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp _Meter mmHg	Δp _Orifice inH ₂ O	Y	Actual Flow [Q_a] m ³ /min
1	0.697	754.620	23.58	23.57	55.435	1.801	0.842	0.646
2	0.911	754.598	23.60	23.59	53.009	3.103	1.105	0.847
3	0.994	754.634	23.63	23.59	37.259	3.897	1.238	0.945
4	1.068	754.594	23.60	23.60	30.590	4.583	1.342	1.025
5	1.168	754.516	23.66	23.57	26.412	5.522	1.474	1.127

Slope (m): **1.31546**

Intercept (b): **-0.00746**

Correlation coefficient (r): **0.99988**

Uncertainty ($k=2$): **0.015** m³/min

Table 2. The results of Q standard calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp _Meter mmHg	Δp _Orifice inH ₂ O	Y	Standard Flow [Q_{std}] m ³ /min
1	0.697	754.620	23.58	23.57	55.435	1.801	1.341	0.644
2	0.911	754.598	23.60	23.59	53.009	3.103	1.759	0.845
3	0.994	754.634	23.63	23.59	37.259	3.897	1.972	0.943
4	1.068	754.594	23.60	23.60	30.590	4.583	2.138	1.022
5	1.168	754.516	23.66	23.57	26.412	5.522	2.347	1.124

Slope (m): **2.10029**

Intercept (b): **-0.01193**

Correlation coefficient (r): **0.99988**

Uncertainty ($k=2$): **0.016** m³/min

End of Certificate of Calibration

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E07NI99E15A0002
Cylinder Number: EB0125123
Laboratory: 124 - Durham (SAP) - NC
PGVP Number: B22019
Gas Code: APPVD

Reference Number: 122-401652592-1
Cylinder Volume: 143.7 Cubic Feet
Cylinder Pressure: 2016 PSIG
Valve Outlet: 660
Certification Date: Nov 06, 2019

Expiration Date: Nov 06, 2027

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	55.00 PPM	54.81 PPM	G1	+/- 0.9% NIST Traceable	10/29/2019, 11/06/2019
NITRIC OXIDE	55.00 PPM	54.80 PPM	G1	+/- 0.9% NIST Traceable	10/29/2019, 11/06/2019
SULFUR DIOXIDE	55.00 PPM	52.99 PPM	G1	+/- 1.0% NIST Traceable	10/29/2019, 11/06/2019
METHANE	180.0 PPM	172.9 PPM	G1	+/- 0.7% NIST Traceable	10/29/2019
PROPANE	180.0 PPM	178.5 PPM	G1	+/- 1.3% NIST Traceable	10/30/2019
CARBON DIOXIDE	950.0 PPM	958.7 PPM	G1	+/- 0.6% NIST Traceable	10/29/2019
CARBON MONOXIDE	4500 PPM	4469 PPM	G1	+/- 0.7% NIST Traceable	10/30/2019
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060657	CC465102	50.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
PRM	PRM	D562879	10.01 PPM NITROGEN DIOXIDE/AIR	+/- 1.9%	Aug 17, 2018
NTRM	17060225	EB0079096	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
RGM	12362	SG916305BAL	4.701% % PROPANE/NITROGEN	+/- 0.3%	Jun 04, 2020
GMIS	124206889114	CC322698	4.432 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Aug 15, 2021
NTRM	14010338	ND48595	49.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.9%	Apr 17, 2024
NTRM	12060910	CC356255	98.05 PPM METHANE/NITROGEN	+/- 0.6%	Dec 22, 2023
NTRM	10060806	CC317625	933.7 PPM CARBON DIOXIDE/NITROGEN	+/- 0.5	May 09, 2020
NTRM	080123	KAL004604	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024
GMIS	124504060104	CC86856	4.8803 % PROPANE/NITROGEN	+/- 0.4%	Oct 22, 2023

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 AHR0801549 CO2	FTIR	Oct 17, 2019
Horiba VIA510 CO RS2EGL6K	Nondispersive Infrared (NDIR)	Oct 30, 2019
Nicolet 6700 AHR0801549 CH4	FTIR	Oct 17, 2019
Nicolet 6700 AHR0801549 NO	FTIR	Oct 17, 2019
Nicolet 6700 AHR0801549 NO	FTIR	Oct 17, 2019
Varian 3800 C3H8	Gas Chromatograph	Oct 02, 2019
Nicolet 6700 AHR0801549 SO2	FTIR	Oct 17, 2019

Triad Data Available Upon Request

NOTES: GROSS WEIGHT: 28,750 g

NET WEIGHT: 4,327.9 g



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0316

MTC No. EEL. BP. 103/0266

CALIBRATION CERTIFICATE

Submitted by : TOPS-LAB Consultants Co.,Ltd.

Address : 189 Moo 3, Bangrakphattana Bangbuathong Nonthaburi 11110.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : QUEST

Model : QC-10

Serial No. : QIK100282

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

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

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

- Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 4. Digital Multimeter Agilent 34401A S/N MY44005560.
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 6. Audio Analyzer Keithley 2015-P S/N 4106495.
 7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 15 Feb. 2023

Date of Calibration : 22 Feb. 2023

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0316

MTC No. EEL. BP. 103/0266

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 114 dB re 20 μ Pa at 1000 Hz

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	114.05	0.05	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	992.4	-7.6	± 1.5	$\pm 1.0\%$

3. Total Distortion

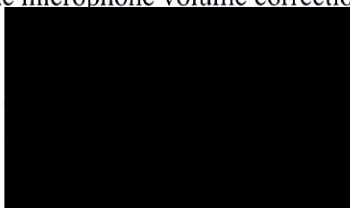
Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	0.40	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Feb. 2023

Date of Issue : 23 Feb. 2023

Ref : 2011266021500681001

End of Certificate

2 / 2

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

Head Office

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Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

Calibration Certificate

Part Number: 721A2601

Description: Micromate with DIN Geophone

Serial Number: UM20764

Calibration Date: **AUG 24 2022**

Calibration Reference Equipment: 714J7402

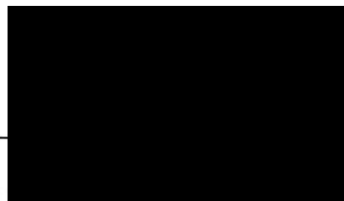
Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

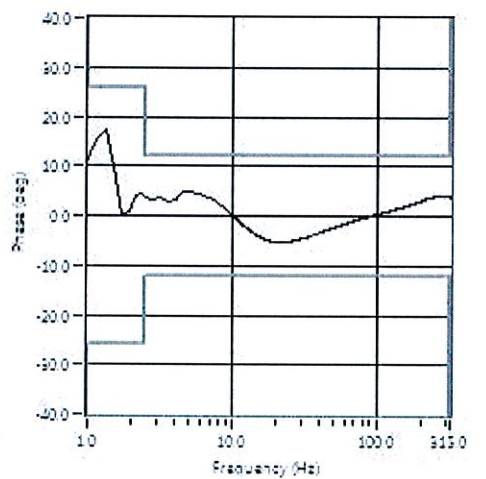
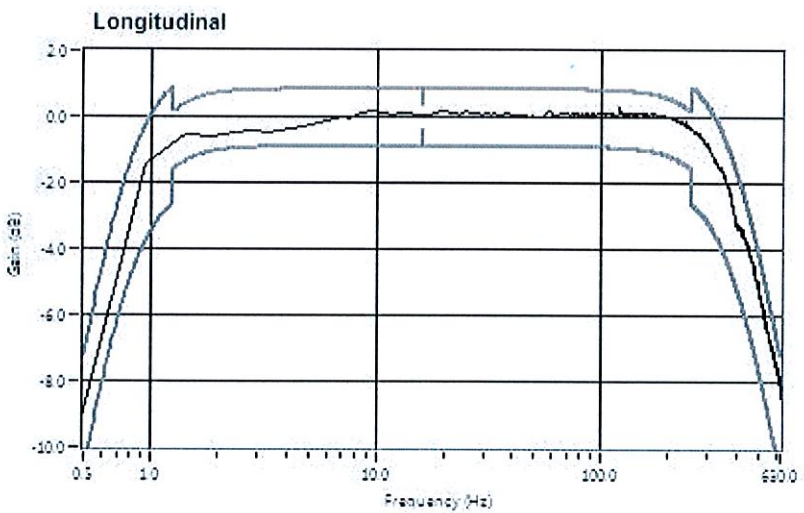
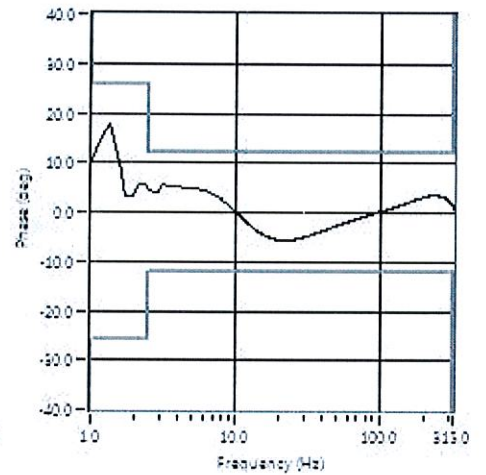
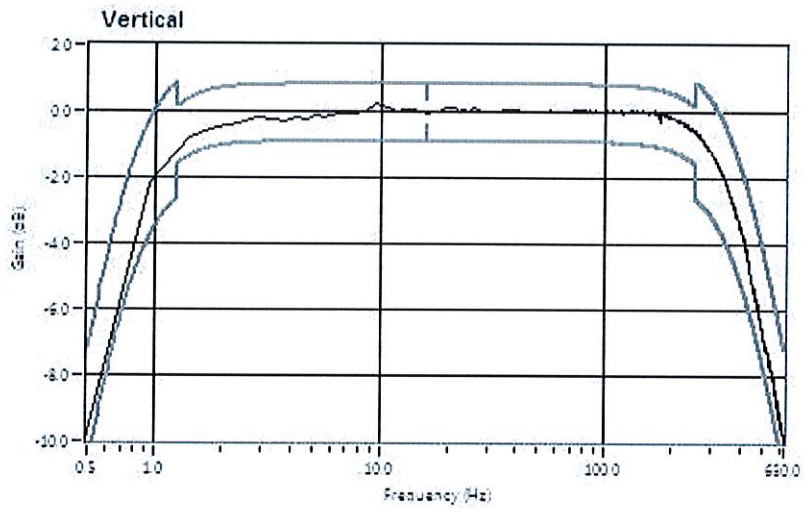
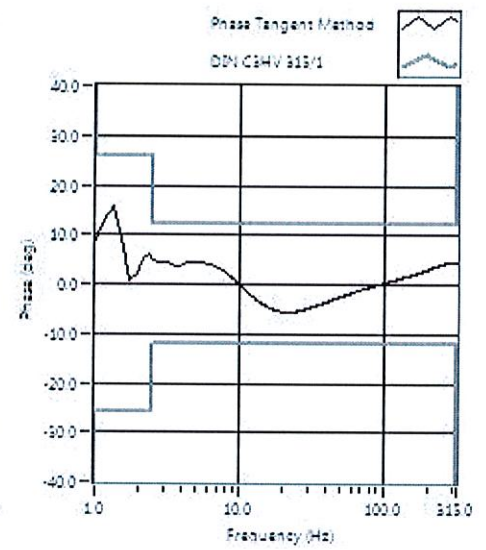
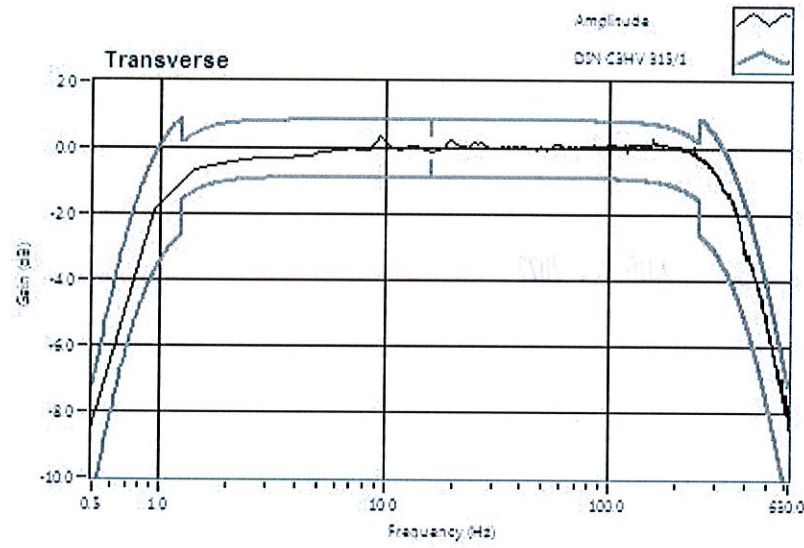
Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: _____



309 Legget Drive, Ottawa, Ontario, K2K 3A3, (613) 592-4642

Frequency Response of UM20764





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



Cert.No.: 23CH579

Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact S220
Serial No. : B635935610
ID No. : TLC-L067
Condition As-Received: Used Item
Received Date : 09 May 2023
Calibration Date : 10 May 2023
Reference : 2305-0243DN-1
Submitted by : Tops-Lab Consultants Co.,Ltd.
189 Moo. 3, Bangrakphatthana,
Bangbuathong, Nonthaburi 11110
Ambient Temperature : (25 \pm 2.5) °C
Relative Humidity : (50 \pm 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lerngagtrakul

Approved by :

(✓) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 16 May 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.

A 0054243



Cert.No.: 23CH579

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	22I1306	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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 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 (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B635935610	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	0.0	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 23CH579

Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 5455014	4.008	4.009	174.1	0.0044	2.00
	6.987	6.988	-0.2	0.0088	2.00
	10.010	10.005	-173.5	0.0068	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM

- Serial No. : 5455014

Dimension of probe;

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
23.0	23.002	23.0	-0.002	0.13	2.00
25.0	25.002	25.0	-0.002	0.13	2.00
27.0	27.003	27.0	-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-

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com



CERTIFICATE No : 23T4233

REFERENCE No : 69097-5

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : INCUBATOR

MANUFACTURER : AQUALYTIC

MODEL : ET618-4

SERIAL No : 0109/13922

ID No : TLC-L005

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TOPS-LAB CONSULTANTS CO., LTD.
189 MOO.3 BANGRAKPHATTHANA
BANGBUATHONG NONTABURI 11110

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-May-23

APPROVED BY : 

ISSUED DATE : 17-May-23

RECEIVED DATE : 15-May-23



CERTIFICATE No : 23T4233

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : INCUBATOR
MANUFACTURER : AQUALYTIC
MODEL : ET618-4
ID No : TLC-L005
RECEIVED DATE : 15-May-23
AMBIENT TEMPERATURE : 26 °C ± 1 °C

S/N : 0109/13922
CALIBRATION DATE : 15-May-23
RELATIVE HUMIDITY : 52 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

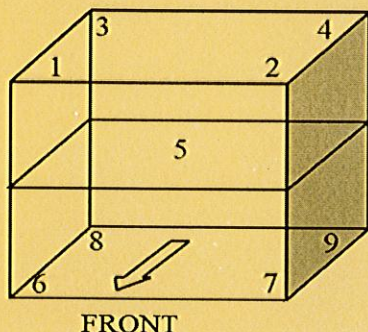
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	6635300	22T7509	10-Jul-23

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 THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 0
Overall Line Voltage (V) variation : 0
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*48 cm

CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
20.0	20.0	0.35	0.37	1.00

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
20.0	20.0	19.77	19.73	19.75	19.74	19.80	19.78	19.80	20.05	19.77	0.45

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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



CERTIFICATE No : 23M4229

REFERENCE No : 69097-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : ELECTRONIC BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : AE 240-S

SERIAL No : K59437

ID No : TLC-L001

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TOPS-LAB CONSULTANTS CO., LTD.
189 MOO.3 BANGRAKPHATTHANA
BANGBUATHONG NONTHABURI 11110

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 15-May-23

APPROVED BY : 

ISSUED DATE : 17-May-23

RECEIVED DATE : 15-May-23



CERTIFICATE No : 23M4229

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : ELECTRONIC BALANCE MODEL : AE 240-S
MANUFACTURER : METTLER TOLEDO S/N : K59437
ID No : TLC-L001 RECEIVED DATE : 15-May-23
AIR PRESSURE : 1009mbar \pm 1mbar CALIBRATION DATE : 15-May-23
AMBIENT TEMPERATURE : 24° C \pm 1° C RELATIVE HUMIDITY : 50 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

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 THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

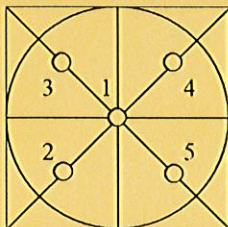
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.0	0.0000	0.0000	0.000058
0.1	0.1001	-0.0001	0.000059
0.2	0.2001	-0.0001	0.000059
0.5	0.5001	-0.0001	0.000060
1.0	1.0002	-0.0002	0.000060
2.0	2.0002	-0.0002	0.000061
5.0	5.0002	-0.0002	0.000063
10.0	10.0003	-0.0003	0.000067
20.0	20.0005	-0.0005	0.000073
50.0	50.0006	-0.0006	0.00011
100.0	100.0015	-0.0015	0.00019

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0006
2	50.0007
3	50.0006
4	50.0002
5	50.0001
OFF-CENTER LOADING	0.0005

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

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



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CERTIFICATE No : 23T4240

REFERENCE No : 69098-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : WATER BATH

MANUFACTURER : MEMMERT

MODEL : WNE14

SERIAL No : L410.1294

ID No : TLC-L009

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TOPS-LAB CONSULTANTS CO., LTD.
189 MOO.3 BANGRAKPHATTHANA
BANGBUATHONG NONTABURI 11110

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-May-23

APPROVED BY : 

ISSUED DATE : 17-May-23

RECEIVED DATE : 15-May-23

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



CERTIFICATE No : 23T4240

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : WATER BATH
MANUFACTURER : MEMMERT
ID NUMBER : TLC-L009
RECEIVED DATE : 15-May-23
AMBIENT TEMPERATURE : $28^{\circ}\text{C} \pm 1^{\circ}\text{C}$
MODEL : WNE14
SERIAL NUMBER : L410.1294
CALIBRATION DATE : 15-May-23
RELATIVE HUMIDITY : $56\% \text{RH} \pm 10\% \text{RH}$

CONDITION OF THIS RESULTS OF CALIBRATION

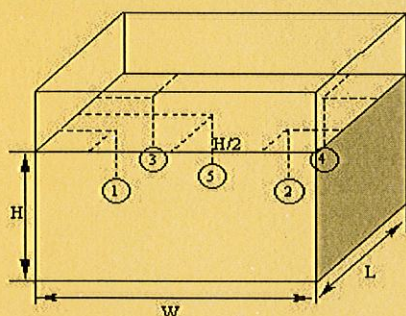
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001) BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE LOCATION) UNDER NO LOAD CONDITION.

2. REFERENCE STANDARD INSTRUMENTS :-

<u>INSTRUMENT</u>	<u>MODEL</u>	<u>SERIAL No</u>	<u>CERTIFICATE No</u>	<u>DUE DATE</u>
1) DATA LOGGER WITH RTD	2635A	7286308	22T7513	05-Jul-23

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 THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



PROBE INSTALLATION
POSITION IN THE BATH

GENERAL INFORMATION

Overall Variation of Ambient Temperature around the Bath ($^{\circ}\text{C}$) : 1
Overall Variation of Line Voltage (V) : 6
Instrument Condition : Normal
Bath Inner Size (W*L*H) : 35*29*14 cm

BATH PERFORMANCE

Controller Temperature ($^{\circ}\text{C}$)	Temperature Stability ($\pm^{\circ}\text{C}$)	Radius Uniformity ($^{\circ}\text{C}$)	Axial Uniformity ($^{\circ}\text{C}$)	Overall Variation ($^{\circ}\text{C}$)
85.0	0.10	0.14	0.05	0.31
95.0	0.31	0.49	0.23	0.81

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp ($^{\circ}\text{C}$)	Indicating Temp ($^{\circ}\text{C}$)	Measured Temperature ($^{\circ}\text{C}$) at Spread Locations					Uncertainty ($\pm^{\circ}\text{C}$)
		#1	#2	#3	#4	Ref. 5	
85.0	85.0	83.75	83.78	83.90	83.85	83.81	0.17
95.0	95.0	93.70	93.93	93.96	94.19	94.10	0.38

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE BATH.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

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CERTIFICATE No : 23T4232

REFERENCE No : 69097-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : HOT AIR OVEN

MANUFACTURER : MEMMERT

MODEL : UF55

SERIAL No : B214.0908

ID No : TLC-L029

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TOPS-LAB CONSULTANTS CO., LTD.
189 MOO.3 BANGRAKPHATTHANA
BANGBUATHONG NONTABURI 11110

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-May-23

APPROVED BY : 

ISSUED DATE : 17-May-23

RECEIVED DATE : 15-May-23



CERTIFICATE No : 23T4232

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF55
ID No : TLC-L029
RECEIVED DATE : 15-May-23
AMBIENT TEMPERATURE : 29 °C ± 1 °C

S/N : B214.0908
CALIBRATION DATE : 15-May-23
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

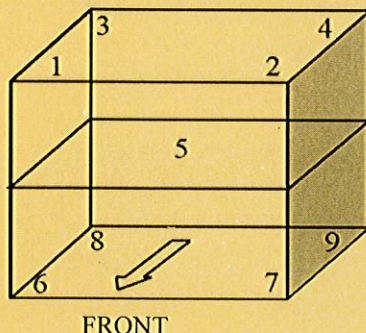
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOCOUPLE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	8009008	22T7511	10-Jul-23

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 THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2
Overall Line Voltage (V) variation : 0
Instrument Condition : Normal
Chamber Size (W*L*H): 40*33*40 cm

CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.0	0.09	1.02	1.06
180.0	180.0	0.14	2.25	2.32

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
104.0	104.0	103.39	103.09	103.44	103.52	104.08	103.43	103.80	103.59	103.90	0.64
180.0	180.0	179.27	178.66	179.39	179.54	180.89	179.48	180.25	180.08	180.66	1.1

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

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CERTIFICATE No : 23T4235

REFERENCE No : 69097-7

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : INCUBATOR

MANUFACTURER : MEMMERT

MODEL : IF 55

SERIAL No : D216.1299

ID No : TLC-L069

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TOPS-LAB CONSULTANTS CO., LTD.
189 MOO.3 BANGRAKPHATTHANA
BANGBUATHONG NONTABURI 11110

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-May-23

APPROVED BY :

ISSUED DATE : 17-May-23

RECEIVED DATE : 15-May-23

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

F-G010 REV : 02



CERTIFICATE No : 23T4235

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : INCUBATOR
MANUFACTURER : MEMMERT
MODEL : IF 55
ID No : TLC-L069
RECEIVED DATE : 15-May-23
AMBIENT TEMPERATURE : 26 °C ± 1 °C

S/N : D216.1299
CALIBRATION DATE : 15-May-23
RELATIVE HUMIDITY : 52 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

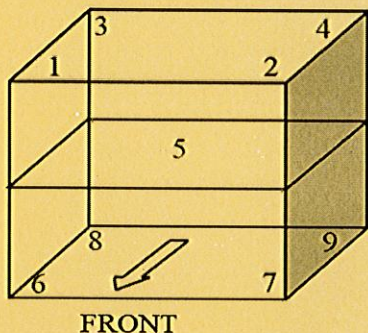
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	7301307	22T7508	10-Jul-23

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 THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1
Overall Line Voltage (V) variation : 0
Instrument Condition : Normal

CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
35.0	35.0	0.05	0.06	0.14
44.5	44.5	0.02	0.12	0.16

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
35.0	35.0	35.02	35.04	35.04	35.04	35.06	35.03	35.02	35.04	35.06	0.25
44.5	44.5	44.52	44.53	44.51	44.52	44.55	44.51	44.46	44.52	44.59	0.36

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

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CERTIFICATE No : 23T4241

REFERENCE No : 69098-5

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : AUTOCLAVE

MANUFACTURER : ZEALWAY

MODEL : GI54TW

SERIAL No : A515D096

ID No : TLC-L081

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TOPS-LAB CONSULTANTS CO., LTD.
189 MOO.3 BANGRAKPHATTHANA
BANGBUATHONG NONTABURI 11110

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-May-23

APPROVED BY : [REDACTED]

ISSUED DATE : 17-May-23

RECEIVED DATE : 15-May-23

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



QUALITY CALIBRATION CO.,LTD.

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CERTIFICATE No : 23T4241

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : AUTOCLAVE
MANUFACTURER : ZEALWAY
ID NUMBER : TLC-L081
RECEIVED DATE : 15-May-23
AMBIENT TEMPERATURE : 29° C ± 1° C

MODEL : GI54TW
SERIAL NUMBER : A515D096
CALIBRATION DATE : 15-May-23
RELATIVE HUMIDITY : 56 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BASED ON BS 2646 : Part 5 : 1993 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON FIVE LOCATIONS AS SHOWN IN THE PICTURE. TWO PROBES WERE PLACES NEAR TOP AND BOTTOM WALL AND EACH PROBE WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE THIRD PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE INSTRUMENT CHAMBER. PROBE NUMBER 4 WAS ATTACHED TO THE LOAD TEMPERATURE PROBE, IF FITTED, WITHIN 20 mm OF ITS TIP. PROBE NUMBER 5 WAS PLACED IN THE CHAMBER DRAIN OR VENT WITHIN 100 mm OF ITS CONNECTION TO THE CHAMBER.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT

MODEL

SERIAL No

CERTIFICATE No

DUE DATE

1) DATA LOGGER

VALPROBE

C653,C654,DW07,EV07

23T0885

27-Jan-24

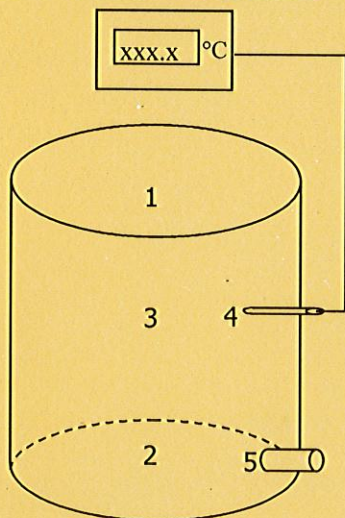
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

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

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber variation : 0.4 °C

Autoclave Condition : Normal

Chamber Size (Diameter*H): 32 * 66 cm

CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)	Pressure (MPa)	Holding time (min)	Operating Cycle time (min)
121.0	121.0	0.04	0.22	0.27	0.115	60	15

TEMPERATURE MEASUREMENT ACCURACY TEST(° C)

Cont Temp	Ind Temp	Measured Temperature (°C) at Spread Locations					Uncertainty (± °C)
		#1	#2	#3	#4	#5	
121.0	121.0	121.74	121.75	121.84	121.67	121.68	0.59

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT OF TEMPERATURE MEASUREMENT ACCURACY TEST EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : THE STABILITY TERM IN THE UNCERTAINTY BUDGET WAS REPLACED BY THE STANDARD REPEATABILITY.

NOTE 3: LOCATION 3 WAS REFERENCE LOCATION.

NOTE 4 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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