

เอกสารสอบเทียบเครื่องมือ
ประจำเดือนกันยายน พ.ศ. 2566

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)	Andersen Instruments, Inc.	G25A 1901	Tisch Environmental, Inc.	05072022	5 Jul 22	4 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1402	9 May 23	8 May 24	-
3	Air Flow Meter	Particular Matter (PM _{2.5})	Mesa Labs	DeltaCal DC1 159822	Innovative Instrument Co., Ltd.	22-AFM-140	7 Sep 22	6 Sep 23	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1859	2 Jun 23	1 Jun 24	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1200	5 Jun 23	5 Jun 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Fisher Scientific	42C 0517512000	UAE Consultant Co., Ltd.	16032023	16 Mar 23	15 Mar 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 0517512001	UAE Consultant Co., Ltd.	20042023	20 Apr 23	19 Apr 24	-
8	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43C-0611116459	UAE Consultant Co., Ltd.	07042023	7 Apr 23	6 Apr 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 43TLC-78567-389	UAE Consultant Co., Ltd.	19042023	19 Apr 23	18 Apr 24	-
11	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
12	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1200636467	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
13	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1200906880	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
14	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
15	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORIBA	APHA-370 RTHK2PDH	UAE Consultant Co.,Ltd.	08022023	8 Feb 23	7 Feb 24	-
16	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORIBA	APHA-370 93JINIMN9	UAE Consultant Co.,Ltd.	15022023	15 Feb 23	14 Feb 24	-
17	Standard Gas	Total Hydrocarbons	Air Liquide	CC143232	Air Liquide	E03AI99E15A006C	16 Oct 20	16 Oct 28	-
18	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM13368	Calibration Laboratory Co.Ltd	Q23015868	13 Feb 23	12 Feb 24	-
19	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35A 73249	Innovative Instrument Co.,Ltd.	23-ACT-111	27 Jun 23	26 Jun 24	-
20	Sound Level Meter	$L_{Aeq\ 24\ hours}$ L_{Amax} เสียงรบกวน	Larson Davis	LxT1 0007303	Larson Davis-A PCB Piezotronics Div.	2023003660	23 Mar 23	22 Mar 25	-
21	Sound Level Meter	$L_{Aeq\ 24\ hours}$ L_{Amax} เสียงรบกวน	Larson Davis	LxT1 0007304	Larson Davis-A PCB Piezotronics Div.	2023003661	23 Mar 23	22 Mar 25	-

Certificate of Calibration

Calibration Certification Information			
Cal. Date: July 5, 2022	Roots meter S/N: 438320	Ta: 297 °K	
Operator: Jim Tisch		Pa: 750.1 mm Hg	
Calibration Model #: G25A	Calibrator S/N: 1901		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3540	3.3	2.00
2	3	4	1	0.9650	6.4	4.00
3	5	6	1	0.8640	8.0	5.00
4	7	8	1	0.8200	8.9	5.50
5	9	10	1	0.6780	12.9	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pa} \right)}$ (y-axis)
0.9859	0.7281	1.4073	0.9956	0.7353	0.8899
0.9818	1.0174	1.9902	0.9915	1.0274	1.2585
0.9797	1.1339	2.2251	0.9893	1.1451	1.4071
0.9785	1.1933	2.3337	0.9881	1.2050	1.4757
0.9732	1.4354	2.8146	0.9828	1.4496	1.7798
QSTD		m= 1.98897	QA		m= 1.24546
		b= -0.03691			b= -0.02334
		r= 0.99996			r= 0.99996

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 (√ ΔH (Pa Pstd) (Tstd Ta)) -b		Qa= 1/m (√ ΔH (Ta/Pa)) -b	

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

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

Tisch Environmental, Inc.
145 South Miami Avenue
Village of Cleves, OH 45002

www.tisch-env.com
TOLL FREE: (877)263-7610
Tel: 937-9009

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL: 0-2717-3000-34 FAX: 0-2719-9484

Certificate of Calibration

Certificate No.: 23P1402
Page: 1 of 2

Equipment: U Tube Manometer
Manufacturer: Dwyer
Model: 1221-35-W/M
Serial No.: -
ID No.: UAE.EFM.1802561

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.

Condition As-Received: Used Item
Received Date: 26 April 2023
Calibration Date: 09 May 2023

Reference: 2304-0703WSC Submitted by: United Analyst and Engineering Consultant Co., Ltd.
Ambient Temperature: (23 ± 2) °C 81 Soi Udomsak 41, Sukhumvit Road, Bangkok,
Relative Humidity: (50 ± 15) % Phrakhanong, Bangkok 10260
Atmospheric Pressure: 1010 mbar

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using * DKD-R 6-1; Calibration of Pressure Gauges, Edition 03/2014 * as a guidelines.

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0137-22	24 Aug 2023
2. This result of calibration was made on requested at the point specified by customer.				
3. Scale and conversion factor is 1 kPa = 4.0146293 inH2O				
4. This instrument was used clean air as pressure media.				
5. This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.				
6. This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.				
7. The certificate is valid only to the item calibrated on date and place of calibration.				
8. This Certification is traceable to the International System of Unit maintained through: - National Institute of Metrology Thailand (NIMT)				

Calibrated by: Suwit Aussanee
Issue Date: 11 May 2023

Approved Signatory: [Signature]
[Signature]
[Signature]
[Signature]

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
719 MOO 13, 301 SUTINAKORN 11 TAMBON BANG KAE, AMPHOE BANG PHU SAMUT PHRAN PROVINCE 10540 THAILAND
TEL: 0800-2116-5000-1 FAX: 0609-2116-7140



Certificate of Calibration

Customer: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Name: 81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Certificate No.: 22-AFM-140
Request No.: Req-2022-1607

Unit Under Calibration Details

Measurement Item: Air Flow meter Sensor Model: -
Manufacturer: BGI Sensor Serial Number: -
Model: Delta Cal DC1
Serial Number: 159822
ID: UAE.EFM.0392561
Location of Calibration: LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature: 23 °C ± 3 °C
Humidity: 55 %RH ± 20 %RH
Barometric Pressure: 1013 hPa ± 10 hPa
Received Date: 22 August 2022
Calibration Date: 7 September 2022

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

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

Traceability: This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI)

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

Calibration By: [Signature]
Mr. Noppadon Luangrat
Service Calibration Engineer

Approved By: [Signature]
Mr. Puan Manan
Calibration Engineer Supervisor
Issue Date: 7 September 2022

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

Result of Calibration :

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

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

End of Certificate

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

FM-708-AFM-01 Rev.00 Issue date 01/07/19

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Certificate of Calibration

Certificate No : 22-TPM-379
Request No : Req-2022-1607
Page : 1/2
Customer
Name : UNITED ANALYST AND ENGINEERING CONSULTANT
CO., LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong,
Bangkok 10260

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DCI
Serial Number : 159822
Resolution : 0.1 °C
ID Number : UAE.EFM.039/2561
Range Calibration : 20 °C to 45 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 3
Calibration Position (mm) : 45
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 22 August 2022
Calibrated Date : 7 September 2022
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

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

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

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

Approved By : 
Mr. Panch Mathavorn
Calibration Engineer Supervisor
Issue Date : 7 September 2022

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

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

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Calibration Note
UUC Adjustment : Not Adjust

Certificate No : 22-TPM-379
Request No : Req-2022-1607
Page : 2/2

Result of Calibration :

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

End of Certificate

Calibrated By : 
Mr. Noppadol Luangrit

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3090-34 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 23P1855
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer : Barigo
Model : -
Serial No. : -
ID No. : UAE.ANV.122/2550
Condition As-Received : Used Item
Received Date : 26 May 2023
Calibration Date : 02 June 2023
Reference : 2305-0919WSC
Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Atmospheric Pressure : 1007 mbar
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

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


Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP1142	1422505048	MP-0094-23	03 May 2024

2. This instrument was installed in vertical orientation and center of the dial was used as the reference level.
3. This result of calibration was made on requested at the point specified by customer.
4. This result of calibration instrument was in absolute pressure.
5. This instrument was used clean air as pressure media.
6. The certificate is valid only to the item calibrated on date and place of calibration.
7. This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankiew
Issue Date : 08 June 2023

Approved Signatory : 
[] Phalinee Prabpai
[] Sura Suwannasri
[x] Attapol Panurach

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Cert.No.: 23P1855
Page: 2 of 2

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

Range: 960 hPa to 1030 hPa
Scale Interval: 1 hPa (The Fifth Estimate)

Increasing Pressure

Applied Pressure (hPa)	958.50	966.59	980.35	990.39	1001.01	1011.15	1020.84	1031.45
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	1.50	0.41	-0.35	-0.39	-1.01	-1.15	-0.94	-1.45

Decreasing Pressure

Applied Pressure (hPa)	1031.45	1021.61	1012.16	1002.36	992.17	982.20	970.69	959.32
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.45	-1.61	-2.16	-2.36	-2.17	-2.20	-0.69	0.68

The uncertainty of measurement was ± 0.30 hPa

* UUC = Unit Under Calibration

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

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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10258
TEL. 0-2717-3000-34 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23H1200
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.ANV.130/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023

Reference: 2305-0919WSC

Ambient Temperature: (25 \pm 3) °C

Relative Humidity: (50 \pm 20) %

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

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

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

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

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	23105	15 Mar 2024

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

3. This Certificate is traceable to the International System of Unit maintained through:-

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

-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by: Somchai Dumwor
Issue Date: 07 June 2023

Approved Signatory:

[] Chakrit Waeewannajua
[] Pornthippa Tameyakul
[] Viporn Tantiyawutti

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Cert. No.: 23H1200
Page: 2 of 2

Result of Calibration:-

Function: Humidity Measurement

Before Adjustment

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	48	7.9	1.6
25.0	60.0	63	3.0	1.7
25.0	80.0	76	-4.0	1.9

Result of Calibration:-

Function: Humidity Measurement

After Adjustment

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	44	3.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	75	-5.0	1.9

Result of Calibration:-

Function: Temperature Measurement

Without Adjustment

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (\pm °C)
19.987	20.0	0.013	0.72
30.016	30.0	-0.016	0.72
39.944	39.5	-0.444	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.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, 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: Apr 20, 2023

Equipment: Gas Analyzer (NO₂) Model: 42C
Manufacturer: Thermo Electron Corporation Serial Number: 0517512001

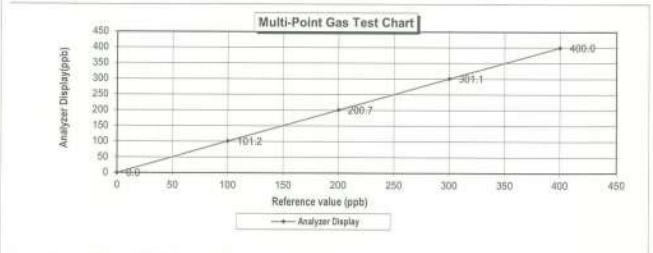
Standard Gas Concentration

Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer:	Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model:	146i
Methane (CH ₄)	-	PPM	Serial Number:	1180540071
Carbon Monoxide (CO)	984.8			
Cylinder No.:	E80143262			
Expiration Date:	Jun 21, 2024			

Dilutor Detail

Multi-point gas test data

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



Calculate by

20 4 11

20 Apr 2023

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MULTI-POINT GAS TEST REPORT

Test Date : Mar 16, 2023

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 0517512000

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

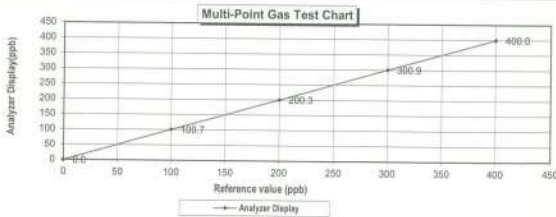
Dilutor Detail

Manufacturer : Thermo Scientific
Model : 1461
Serial Number : 1180540071

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70
Level 3	40.00%	200.0	200.3	0.30	0.15
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$
Average Difference (%) 0.23



Calculate by

16/3/23

16 Mar 2023

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
(Do not Use This Cylinder below 100 psig, i.e. 6.7 megapascals)

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/21/2021
NITROGEN	Balance				09/14/2021

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708008	48.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	DS85025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423836102	CC505981	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14080119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

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

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

Triad Data Available Upon Request

NOTES: PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



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

Approved for Release



CERT 3082.01

เอกสารไม่ควบคุม



MULTI-POINT GAS TEST REPORT

Test Date : Apr 19, 2023

Equipment : Gas Analyzer (SO₂) Model : 43C
Manufacturer : Thermo Environmental Instruments Serial Number : 43CTL-78567-389

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 24, 2024

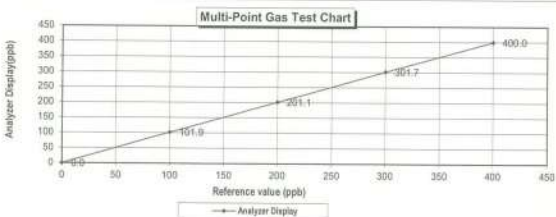
Dilutor Detail

Manufacturer : Thermo SCIENTIFIC
Model : 1461
Serial Number : 1180540071

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	101.9	101.9	1.90	1.86
Level 3	40.00%	201.1	201.1	1.10	0.55
Level 4	60.00%	301.7	301.7	1.70	0.56
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$
Average Difference (%) 0.60



Calculate by

19/4/23

Approve by

19 Apr 2023

เอกสารไม่ควบคุม



MULTI-POINT GAS TEST REPORT

Test Date : Apr 7, 2023

Equipment : Gas Analyzer (SO₂) Model : 43C
Manufacturer : Thermo Electron Corporation Serial Number : 43C-0611116459

Standard Gas Concentration

Sulphur Dioxide (SO₂) 44.68 PPM
Nitric Oxide (NO) 45.94 PPM
Methane (CH₄) - PPM
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 24, 2024

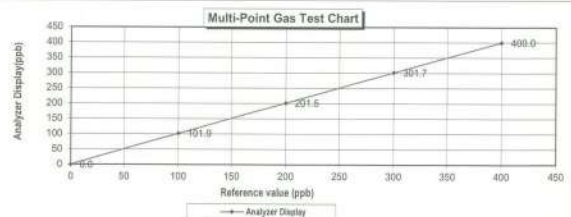
Dilutor Detail

Manufacturer : Thermo SCIENTIFIC
Model : 1461
Serial Number : 1180540071

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	101.9	101.9	1.90	1.86
Level 3	40.00%	201.5	201.5	1.50	0.74
Level 4	60.00%	301.7	301.7	1.70	0.56
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit $\pm 5\%$
Average Difference (%) 0.63



Calculate by

7/4/23

Approve by

7 Apr 2023

เอกสารไม่ควบคุม

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 650
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
NITRIC OXIDE	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.0% NIST Traceable	09/14/2021, 09/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	09/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC708098	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423836102	CC505681	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

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



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

Approved for Release



CERT 3082.01
เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

Equipment : Gas Analyzer (CO) Model : 48i
Manufacturer : Thermo Scientific Serial Number : 1200906880

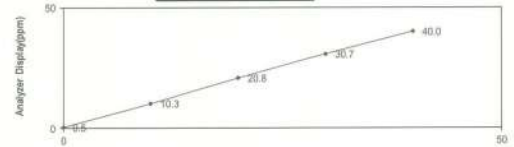
Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 20, 2024	

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.5	0.5	0.5
Level 2 20.00%	10.0	10.3	0.3	2.9
Level 3 40.00%	20.0	20.8	0.8	3.8
Level 4 60.00%	30.0	30.7	0.7	2.3
Level 5 80.00%	40.0	40.0	0.0	0.0

Remark : Measuring Range 50.0 ppm
Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

Approve by

Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

Equipment : Gas Analyzer (CO) Model : 48i
Manufacturer : Thermo Scientific Serial Number : 1200635467

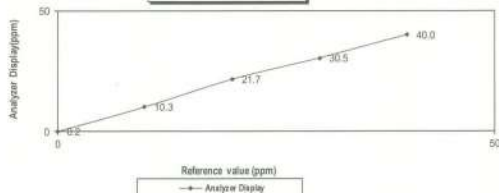
Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 20, 2024	

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.2	0.2	0.2
Level 2 20.00%	10.0	10.3	0.3	2.9
Level 3 40.00%	20.0	21.7	1.7	7.8
Level 4 60.00%	30.0	30.5	0.5	1.6
Level 5 80.00%	40.0	40.0	0.0	0.0

Remark : Measuring Range 50.0 ppm
Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 650
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
NITRIC OXIDE	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.0% NIST Traceable	09/14/2021, 09/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	09/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC708098	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423836102	CC505681	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

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



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

Approved for Release



CERT 3082.01
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MULTI-POINT GAS TEST REPORT

Test Date : Feb 8, 2023

Equipment : Hydrocarbon Analyzer Model : APHA-370
Manufacturer : HORIBA Serial Number : RATFBXS

Standard Gas Concentration

Sulphur Dioxide (SO₂) : PPM
Nitric Oxide (NO) : PPM
Methane (CH₄) : 39.8 PPM
Carbon Monoxide (CO) : PPM
Cylinder No. : D824432
Expiration Date : Aug 4, 2028

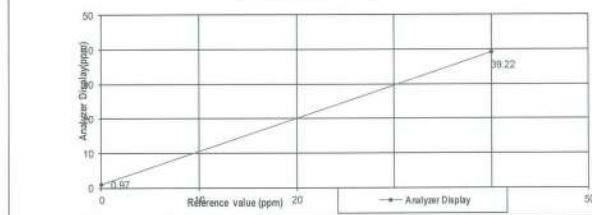
Dilutor Detail

Manufacturer :
Model :
Serial Number :

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.00	0.97	0.97	0.97
Level 2 80.00%	40.00	39.22	-1.99	1.99
Remark : Measuring Range 50.00 ppm		Average Difference (%)		
Acceptable Limit ± 5%		1.48		

Multi-Point Gas Test Chart



Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Feb 15, 2023

Equipment : Hydrocarbon Analyzer Model : APHA-370
Manufacturer : HORIBA Serial Number : 933N1MN9

Standard Gas Concentration

Sulphur Dioxide (SO₂) : PPM
Nitric Oxide (NO) : PPM
Methane (CH₄) : 39.8 PPM
Carbon Monoxide (CO) : PPM
Cylinder No. : D824432
Expiration Date : Aug 4, 2028

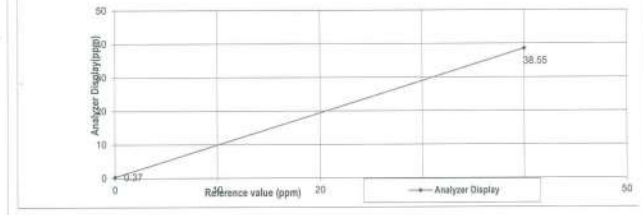
Dilutor Detail

Manufacturer :
Model :
Serial Number :

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.00	0.37	0.37	0.37
Level 2 80.00%	40.00	38.55	-1.45	3.76
Remark : Measuring Range 50.00 ppm		Average Difference (%)		
Acceptable Limit ± 5%		2.07		

Multi-Point Gas Test Chart



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เอกสารไม่ควบคุม



Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 1
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E03A199E15A006C Reference Number: 160-401908379-1
Cylinder Number: CC143232 Cylinder Volume: 144.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2016 PSIG
PGVP Number: A12020 Valve Outlet: 590
Gas Code: CH4,PPN,BALA Certification Date: Oct 16, 2020
Expiration Date: Oct 16, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
METHANE	4000 PPM	4019 PPM	G1	+/- 1.0% NIST Traceable	10/16/2020
PROPANE	4000 PPM	4008 PPM	G1	+/- 0.7% NIST Traceable	10/09/2020
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	02010405	K010090	4976 PPM PROPANE/NITROGEN	+/- 0.6%	Dec 02, 2021
NTRM	170608	CC160290	0.967 % METHANE/NITROGEN	+/- 0.4%	Aug 22, 2023

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CH4 - 000928781	FTIR	Oct 14, 2020
Nicoret 6700 APW1100391 C3H8	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES: NET WEIGHTS: 4.865kg
GROSS WEIGHTS: 27.365kg
PO#: 5220003825



เอกสารไม่ควบคุม



CALIBRATION LABORATORY CO., LTD.

210-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrasa, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.com E-mail: sale@cal-lab.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM13368/UM13368
CLID. NO. : 251900391
JOB CONTROL NO. : 230211015868

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

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 14 February 2023

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
Calibration Engineer



Approved By : Mongkol Yotsontorn
Authorized Signatory
14 February 2023

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. Q23015868

F3-011-04/01-12

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เอกสารไม่ควบคุม



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM13368/UM13368
DATE OF CALIBRATION : 13 February 2023

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$ Relative Humidity : $(55 \pm 15) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-08 based on ISO 16063-21 as calibration guideline.
The calibration was performed by using Digital Multimeter, High Resolution Programmable Timer/Counter, Accelerometer and Measuring Amplifier which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

- Digital Multimeter, Wavetek Model 1281 S/N. 29320.
- High Resolution Programmable Timer/Counter, Philips Model PM6680B S/N. SM607101.
- Accelerometer with Measuring Amplifier, Bruel & Kjaer Model 8305, 2525 S/N. 39701R, 2434988.

TRACEABILITY :

- The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 05-0207/21, Due Date 31 May 2023.
- The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 07-0001/22, Due Date 22 February 2023.
- The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. AV-0009-22, Due Date 22 June 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M-2022)"

Certificate No. Q23015868

F3-011-04/01-12

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เอกสารไม่ควบคุม

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

CALIBRATION DATA

1. ACCELERATION RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(g)	(frequency)		(g)	(g)	(g)	\pm (% of rdg.)
0.3	50 Hz	peak	0.300	0.302	-0.002	1.9
0.4	50 Hz		0.400	0.404	-0.004	1.9
0.5	50 Hz		0.500	0.506	-0.006	1.3
0.6	50 Hz		0.600	0.608	-0.008	1.3
0.7	50 Hz		0.700	0.710	-0.010	1.3
0.3	100 Hz	peak	0.300	0.303	-0.003	1.9
0.4	100 Hz		0.400	0.405	-0.005	1.9
0.5	100 Hz		0.500	0.507	-0.007	1.3
0.6	100 Hz		0.600	0.609	-0.009	1.3
0.7	100 Hz		0.700	0.710	-0.010	1.3

2. VELOCITY RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm/s)	(frequency)		(mm/s)	(mm/s)	(mm/s)	\pm (% of rdg.)
3	50 Hz	peak	3.000	3.022	-0.022	1.8
4	50 Hz		4.000	4.033	-0.033	1.8
5	50 Hz		5.000	5.043	-0.043	1.8
6	50 Hz		6.000	6.051	-0.051	1.8
7	50 Hz		7.000	7.067	-0.067	1.8
3	100 Hz	peak	3.000	3.023	-0.023	1.8
4	100 Hz		4.000	4.031	-0.031	1.8
5	100 Hz		5.000	5.043	-0.043	1.8
6	100 Hz		6.000	6.051	-0.051	1.8
7	100 Hz		7.000	7.063	-0.063	1.8

Certificate No. Q23015868

F3-011-04/01-12

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CALIBRATION DATA

3. DISPLACEMENT RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm)	(frequency)		(mm)	(mm)	(mm)	\pm (% of rdg.)
*0.03	50 Hz	peak	0.030	0.030	0.000	2.1
*0.04	50 Hz		0.040	0.040	0.000	1.7
*0.05	50 Hz		0.050	0.050	0.000	1.5
*0.06	50 Hz		0.060	0.060	0.000	1.3
*0.07	50 Hz		0.070	0.071	-0.001	1.4
0.03	100 Hz	peak	0.030	0.030	0.000	2.1
0.04	100 Hz		0.040	0.040	0.000	1.7
0.05	100 Hz		0.050	0.050	0.000	1.5
0.06	100 Hz		0.060	0.061	-0.001	1.3
0.07	100 Hz		0.070	0.071	-0.001	1.2

Note. * means Calibrations marked * Not ANAB Accredited * in this Certificate have been included for completeness.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 1 of 58

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

End of Certificate

Certificate No. Q23015868

F3-011-04/01-12

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
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AMPHIBANG PHU SAMUT PRACHIN PROVINCE 10140 THAILAND
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Certificate of Calibration

Customer

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

Certificate No : 23-ACT-111
Request No : Req-2023-1408

Unit Under Calibration Details

Measurement item : Acoustic Calibrator
Manufacturer : SVANTEK
Model : SV 35A
Serial Number : 73249
ID : UAE.EFM.105/2561
Class : 1
Range : 94 , 114 dB / 1000 Hz
Instrument Status : Used

Calibration Environment and Details

Temperature : $(23 \pm 2) ^\circ\text{C}$
Humidity : $(50 \pm 20) \% \text{RH}$
Barometric Pressure : $(1013 \pm 10.0) \text{ hPa}$
Received Date : 26 June 2023
Calibration Date : 27 June 2023
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 2024
THD Multimeter	2015	1047765	NIMT	31 January 2024

Traceability : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

Note

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

Calibrated By :

Mr. Noppadon Luangart
Service Calibration Engineer

Approved By :

Mr. Pachi Mathavorn
Calibration Engineer Supervisor

Issue Date : 27 June 2023

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

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Certificate No : 23-ACT-111
Request No : Req-2023-1408

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.84	-0.16	-	-	0.14	0.25
114 dB / 1000 Hz	113.79	-0.21	-	-	0.13	0.25

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (%)	Error (%)	Measured (%)	Error (%)		
94 dB / 1000 Hz	0.17	-	-	-	0.40	2.5
114 dB / 1000 Hz	0.04	-	-	-	0.40	2.5

Note :

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

End of Calibration

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

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Calibration Certificate

Certificate Number 2023003661

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

Model Number LxT1
Serial Number 0007304
Test Results Pass

Initial Condition As Manufactured

Description SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8384
Technician Jacob Cannon
Calibration Date 23 Mar 2023
Calibration Due
Temperature 23.64 °C ± 0.25 °C
Humidity 50.1 %RH ± 2.0 %RH
Static Pressure 85.98 kPa ± 0.13 kPa

Evaluation Method

Tested with:

PCB 377B02, S/N 345233
Larson Davis CAL200, S/N 9079
Larson Davis PRMLX1, S/N 077639
Larson Davis CAL291, S/N 0108

Data reported in dB re 20 µPa.

Compliance Standards

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

IEC 60651:2001 Type 1
IEC 60804:2000 Type 1
IEC 61252:2002
IEC 61260:2001 Class 1
IEC 61672:2013 Class 1

ANSI S1.4-2014 Class 1
ANSI S1.4 (R2008) Type 1
ANSI S1.11 (R2009) Class 1
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 1

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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Certificate Number 2023003661

1/2" adaptor is used with the preamplifier.

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

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

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-034218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1; the sound level meter submitted for testing conforms to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Description	Standards Used		
	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL290 Acoustic Calibrator	2022-07-21	2023-07-21	007037
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Pre-polarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS560 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

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

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.52	-52.44	-48.33	0.14	Pass

— End of measurement results—

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.21	-0.20	-1.20	0.80	0.23	Pass
1000	0.18	0.00	-0.70	0.70	0.23	Pass
8000	-3.39	-3.00	-6.50	-1.50	0.32	Pass

— End of measurement results—

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Certificate Number 2023003661

Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	47.44

— End of measurement results—

— End of Report—

Signature:

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Calibration Certificate

Certificate Number 2023003633

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

Model Number LxT1
Serial Number 0007304
Test Results Pass
Initial Condition As Manufactured
Description SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378
Technician Jacob Cannon
Calibration Date 23 Mar 2023
Calibration Due
Temperature 23.57 °C ± 0.25 °C
Humidity 50.3 %RH ± 2.0 %RH
Static Pressure 86.12 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077639 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1
IEC 60804:2000 Type 1
IEC 61252:2002
IEC 61672:2013 Class 1
IEC 61260:2001 Class 1

ANSI S1.4-2014 Class 1
ANSI S1.4 (R2008) Type 1
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 1
ANSI S1.11 (R2009) Class 1

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

The quality system is registered to ISO 9001:2015.

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

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

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Ltd, 1770.01 Rev O Supporting Firmware Version 4.0.8, 2019 09 10

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

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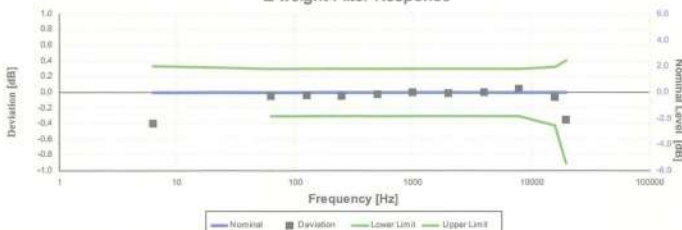
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Certificate Number 2023003633

Z-weight Filter Response



Electrical signal list of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5, IEC 60651:2001 6.1 and 9.2.2, IEC 60804:2000 5, ANSI S1.4-1983 (R2006) 5.1 and 8.2.1, ANSI S1.4-2014 Part 1: 8.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.40	-0.40	-1.11	0.33	0.15	Pass
63.10	-0.05	-0.05	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,003.30	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.01	-0.01	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.04	0.04	-0.30	0.30	0.15	Pass
15,848.93	-0.06	-0.06	-0.42	0.32	0.15	Pass
19,952.62	-0.35	-0.35	-0.91	0.41	0.15	Pass

– End of measurement results –

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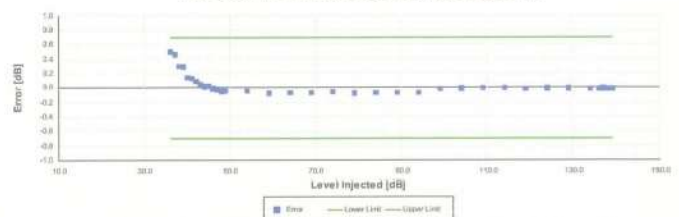
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Certificate Number 2023003633

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.8, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.8, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.50	-0.70	0.70	0.16	Pass
37.00	0.46	-0.70	0.70	0.16	Pass
38.00	0.30	-0.70	0.70	0.16	Pass
39.00	0.29	-0.70	0.70	0.16	Pass
40.00	0.15	-0.70	0.70	0.16	Pass
41.00	0.13	-0.70	0.70	0.16	Pass
42.00	0.09	-0.70	0.70	0.16	Pass
43.00	0.04	-0.70	0.70	0.17	Pass
44.00	0.02	-0.70	0.70	0.17	Pass
45.00	0.02	-0.70	0.70	0.16	Pass
46.00	-0.01	-0.70	0.70	0.16	Pass
47.00	-0.02	-0.70	0.70	0.16	Pass
48.00	-0.05	-0.70	0.70	0.16	Pass
49.00	-0.04	-0.70	0.70	0.16	Pass
50.00	-0.04	-0.70	0.70	0.16	Pass
59.00	-0.07	-0.70	0.70	0.16	Pass
64.00	-0.07	-0.70	0.70	0.16	Pass
69.00	-0.07	-0.70	0.70	0.16	Pass
74.00	-0.06	-0.70	0.70	0.16	Pass
79.00	-0.07	-0.70	0.70	0.16	Pass
84.00	-0.07	-0.70	0.70	0.16	Pass
89.00	-0.07	-0.70	0.70	0.16	Pass
94.00	-0.07	-0.70	0.70	0.16	Pass
99.00	-0.01	-0.70	0.70	0.15	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	0.00	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	-0.01	-0.70	0.70	0.15	Pass
124.00	-0.01	-0.70	0.70	0.15	Pass
129.00	-0.01	-0.70	0.70	0.15	Pass
134.00	-0.01	-0.70	0.70	0.15	Pass
136.00	-0.01	-0.70	0.70	0.15	Pass
137.00	-0.01	-0.70	0.70	0.15	Pass
138.00	-0.01	-0.70	0.70	0.15	Pass
139.00	-0.02	-0.70	0.70	0.15	Pass

– End of measurement results –

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Peak Rise Time

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

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.19	133.74	135.74	0.15	Pass
		Positive Pulse	135.20	133.73	135.73	0.15	Pass
		Negative Pulse	134.28	133.74	135.74	0.15	Pass
	30	Negative Pulse	134.25	133.73	135.73	0.15	Pass
		Positive Pulse					
		Positive Pulse					

-- End of measurement results --

Positive Pulse Crest Factor

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

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.12	± 0.50	0.15 ±	Pass
	5	-0.11	± 1.00	0.16 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.26	± 1.50	0.15 ±	Pass
106.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.16	± 1.50	0.15 ±	Pass

-- End of measurement results --

Negative Pulse Crest Factor

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

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.11	± 0.50	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.25	± 1.50	0.15 ±	Pass
106.85	3	-0.12	± 0.50	0.15 ±	Pass
	5	-0.11	± 1.00	0.15 ±	Pass
	10	-0.16	± 1.50	0.15 ±	Pass

-- End of measurement results --



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Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.95	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.09	40.30	41.70	0.16	Pass
CBA Low Range	94.00	93.90	94.10	0.15	Pass
CBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results --

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	29.43	36.00	Pass
C-weight Noise Floor	28.93	35.00	Pass
Z-weight Noise Floor	33.44	39.00	Pass

-- End of measurement results --

Total Harmonic Distortion

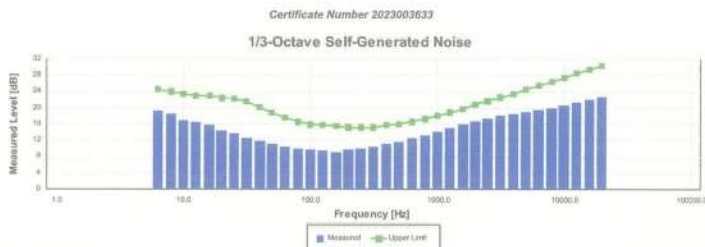
Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.76	135.05	136.65	0.15	Pass
THD	-66.65	-58.00	-58.00	0.01 ±	Pass
THD+N	-62.62	-58.00	-58.00	0.01 ±	Pass

-- End of measurement results --



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The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	19.29	24.60	Pass
8.00	18.45	24.00	Pass
10.00	16.85	23.50	Pass
12.50	16.37	23.00	Pass
16.00	15.82	22.90	Pass
20.00	14.52	22.40	Pass
25.00	13.64	22.30	Pass
31.50	12.57	21.50	Pass
40.00	11.80	20.20	Pass
50.00	11.13	18.80	Pass
63.00	10.46	17.60	Pass
80.00	10.08	16.60	Pass
100.00	9.85	15.90	Pass
125.00	9.47	15.70	Pass
160.00	9.11	15.50	Pass
200.00	9.57	15.20	Pass
250.00	10.03	15.20	Pass
315.00	10.45	15.20	Pass
400.00	11.08	15.70	Pass
500.00	11.68	16.00	Pass
630.00	12.49	16.60	Pass
800.00	13.31	17.30	Pass
1,000.00	14.19	18.10	Pass
1,250.00	15.03	18.90	Pass
1,600.00	15.92	19.80	Pass
2,000.00	16.69	20.80	Pass
2,500.00	17.42	21.70	Pass
3,150.00	18.00	22.60	Pass
4,000.00	18.51	23.50	Pass
5,000.00	18.96	24.50	Pass
6,300.00	19.51	25.50	Pass
8,000.00	20.05	26.50	Pass
10,000.00	20.57	27.40	Pass
12,500.00	21.26	28.50	Pass
16,000.00	21.97	29.50	Pass
20,000.00	22.79	30.40	Pass

-- End of measurement results --



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-- End of Report --

Signature:



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Calibration Certificate

Certificate Number 2023003660

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

Model Number	LxT1	Procedure Number	D0001.8384
Serial Number	0007303	Technician	Jacob Cannon
Test Results	Pass	Calibration Date	23 Mar 2023
Initial Condition	As Manufactured	Calibration Due	
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	Temperature	23.68 °C ± 0.25 °C
		Humidity	49.4 %RH ± 2.0 %RH
		Static Pressure	86 kPa ± 0.13 kPa

Evaluation Method Tested with: Data reported in dB re 20 µPa.
Larson Davis PRMLxT1, S/N 077638
PCB 377B02, S/N 345232
Larson Davis CAL291, S/N 0108
Larson Davis CAL200, S/N 9079

Compliance Standards	Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:
	IEC 60651:2001 Type 1 IEC 60804:2000 Type 1 IEC 61252:2002 IEC 61260:2001 Class 1 IEC 61672:2013 Class 1
	ANSI S1.4-2014 Class 1 ANSI S1.4 (R2008) Type 1 ANSI S1.11 (R2009) Class 1 ANSI S1.25 (R2007) ANSI S1.43 (R2007) Type 1

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

The quality system is registered to ISO 9001:2015.

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

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

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

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Certificate Number 2023003660

1/2" adaptor is used with the preamplifier.

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

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

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-0334218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1; the sound level meter submitted for testing conforms to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Description	Standards Used		
	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2023-07-21	2023-07-21	007027
Larson Davis Model 931	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 931 Type 1	2023-09-28	2023-09-28	PCB0094783

Acoustic Calibration

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

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.56	-52.44	-48.33	0.14	Pass

– End of measurement results–

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.23	-0.20	-1.20	0.80	0.23	Pass
1000	0.17	0.00	-0.70	0.70	0.23	Pass
8000	-3.19	-3.00	-5.50	-1.50	0.32	Pass

– End of measurement results–

LARSON DAVIS – A PCB DIVISION
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

2023-3-27T17:30:48



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D0001.8406 Rev G

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Certificate Number 2023003660

Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	42.55

– End of measurement results–

– End of Report–

Signature: 

LARSON DAVIS – A PCB DIVISION
1681 West 820 North
Provo, UT 84601, United States
716-684-0001



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D0001.8406 Rev G

เอกสารไม่ควบคุม

Calibration Certificate

Certificate Number 2023003636

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

Model Number	LxT1	Procedure Number	D0001.8378
Serial Number	0007303	Technician	Jacob Cannon
Test Results	Pass	Calibration Date	23 Mar 2023
Initial Condition	As Manufactured	Calibration Due	
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	Temperature	23.66 °C ± 0.25 °C
		Humidity	50.2 %RH ± 2.0 %RH
		Static Pressure	86.12 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077638 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1 IEC 60804:2000 Type 1 IEC 61252:2002 IEC 61672:2013 Class 1 IEC 61260:2001 Class 1	ANSI S1.4-2014 Class 1 ANSI S1.4 (R2008) Type 1 ANSI S1.25 (R2007) ANSI S1.43 (R2007) Type 1 ANSI S1.11 (R2009) Class 1
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Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

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

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

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

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

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

LARSON DAVIS – A PCB DIVISION
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

2023-3-27T17:30:48



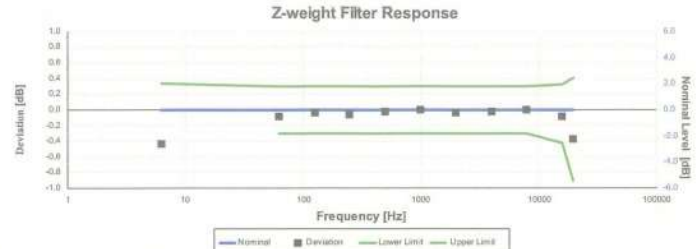
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D0001.8407 Rev G

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Description	Standards Used	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe		2021-08-25	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator		2022-12-29	2023-12-29	007118



Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5, IEC 60651:2001 6.1 and 9.2.2, IEC 60804:2000 9, ANSI S1.4-1983 (R2006) 5.1 and 5.2.1, ANSI S1.4-2014 Part 1: 5.5

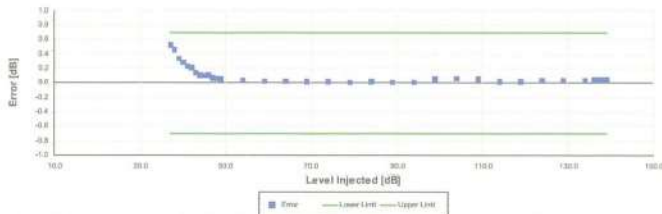
Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.43	-0.43	-1.11	0.33	0.15	Pass
63.10	-0.08	-0.08	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.06	-0.06	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-0.03	-0.30	0.30	0.15	Pass
3,981.07	-0.02	-0.02	-0.30	0.30	0.15	Pass
7,943.28	0.00	0.00	-0.30	0.30	0.15	Pass
15,848.93	-0.08	-0.08	-0.42	0.32	0.15	Pass
19,952.62	-0.37	-0.37	-0.91	0.41	0.15	Pass

— End of measurement results—

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.8, IEC 60804:2000 8.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 8.2, ANSI S1.4-2014 Part 1: 5.8, ANSI S1.4.3 (R2007) 8.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
37.00	0.53	-0.70	0.70	0.16	Pass
38.00	0.46	-0.70	0.70	0.16	Pass
39.00	0.33	-0.70	0.70	0.16	Pass
40.00	0.29	-0.70	0.70	0.16	Pass
41.00	0.23	-0.70	0.70	0.16	Pass
42.00	0.22	-0.70	0.70	0.16	Pass
43.00	0.15	-0.70	0.70	0.17	Pass
44.00	0.11	-0.70	0.70	0.17	Pass
45.00	0.10	-0.70	0.70	0.16	Pass
46.00	0.11	-0.70	0.70	0.16	Pass
47.00	0.07	-0.70	0.70	0.16	Pass
48.00	0.06	-0.70	0.70	0.16	Pass
49.00	0.06	-0.70	0.70	0.16	Pass
54.00	0.04	-0.70	0.70	0.16	Pass
59.00	0.02	-0.70	0.70	0.16	Pass
64.00	0.02	-0.70	0.70	0.16	Pass
69.00	0.02	-0.70	0.70	0.16	Pass
74.00	0.02	-0.70	0.70	0.16	Pass
79.00	0.01	-0.70	0.70	0.16	Pass
84.00	0.02	-0.70	0.70	0.16	Pass
89.00	0.01	-0.70	0.70	0.16	Pass
94.00	0.01	-0.70	0.70	0.16	Pass
99.00	0.06	-0.70	0.70	0.15	Pass
104.00	0.06	-0.70	0.70	0.15	Pass
109.00	0.06	-0.70	0.70	0.15	Pass
114.00	0.02	-0.70	0.70	0.15	Pass
119.00	0.02	-0.70	0.70	0.15	Pass
124.00	0.04	-0.70	0.70	0.15	Pass
129.00	0.04	-0.70	0.70	0.15	Pass
134.00	0.04	-0.70	0.70	0.15	Pass
136.00	0.04	-0.70	0.70	0.15	Pass
137.00	0.04	-0.70	0.70	0.15	Pass
138.00	0.05	-0.70	0.70	0.15	Pass
139.00	0.04	-0.70	0.70	0.15	Pass

— End of measurement results—

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Peak Rise Time

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

Amplitude [dB]	Duration [μs]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.21	133.74	0.15	Pass
		Positive Pulse	135.21	133.73	0.15	Pass
	30	Negative Pulse	134.28	133.74	0.15	Pass
		Positive Pulse	134.23	133.73	0.15	Pass

— End of measurement results—

Positive Pulse Crest Factor

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

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVL	± 0.50	0.15 ±	Pass
	5	OVL	± 1.00	0.15 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
126.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.16 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
116.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
	10	-0.05	± 1.50	0.15 ±	Pass
106.85	3	-0.15	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.17	± 1.50	0.15 ±	Pass

— End of measurement results—

Negative Pulse Crest Factor

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

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVL	± 0.50	0.15 ±	Pass
	5	OVL	± 1.00	0.15 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
126.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
116.85	3	-0.14	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
	10	0.00	± 1.50	0.15 ±	Pass
106.85	3	-0.15	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
	10	-0.17	± 1.50	0.15 ±	Pass

— End of measurement results—

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Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.95	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.13	40.30	41.70	0.16	Pass
OBA Low Range	94.00	93.90	94.10	0.15	Pass
OBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	27.01	36.00	Pass
C-weight Noise Floor	26.70	35.00	Pass
Z-weight Noise Floor	32.64	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.76	135.05	136.65	0.15	Pass
THD	-67.22	-68.00	-66.00	0.01 ±	Pass
THD+N	-62.91	-68.00	-58.00	0.01 ±	Pass

-- End of measurement results--



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1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	18.55	24.50	Pass
8.00	18.33	24.00	Pass
10.00	18.11	23.50	Pass
12.50	16.77	23.00	Pass
16.00	15.74	22.90	Pass
20.00	14.70	22.40	Pass
25.00	13.54	22.30	Pass
31.50	13.13	21.50	Pass
40.00	12.18	20.20	Pass
50.00	10.89	18.80	Pass
63.00	10.30	17.60	Pass
80.00	9.05	16.60	Pass
100.00	9.08	15.90	Pass
125.00	8.51	15.70	Pass
160.00	7.86	15.50	Pass
200.00	7.66	15.20	Pass
250.00	7.66	15.20	Pass
315.00	7.68	15.20	Pass
400.00	7.98	15.70	Pass
500.00	8.38	16.00	Pass
630.00	8.87	16.60	Pass
800.00	9.56	17.30	Pass
1,000.00	10.29	18.10	Pass
1,250.00	11.10	18.90	Pass
1,600.00	11.90	19.80	Pass
2,000.00	12.78	20.80	Pass
2,500.00	13.70	21.70	Pass
3,150.00	14.55	22.60	Pass
4,000.00	15.48	23.50	Pass
5,000.00	16.50	24.50	Pass
6,300.00	17.50	25.50	Pass
8,000.00	18.46	26.50	Pass
10,000.00	19.44	27.40	Pass
12,500.00	20.45	28.50	Pass
16,000.00	21.46	29.50	Pass
20,000.00	22.43	30.40	Pass

-- End of measurement results--



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-- End of Report--

Signature: _____



เอกสารไม่ควบคุม

List of Instrument/Equipment Certification for Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model / Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Laboratory Instrument/Equipments Water Quality Analysis.									
1	pH Meter	pH Temperature	Mettler-Toledo	SevenEasy pH/ 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-1	24 Mar 23	22 Mar 24	-
2	Analytical Balance (Readability 0.01 mg)	Suspended Solids Total Dissolved Solids	Mettler-Toledo	AB204-S/ 1128312528	Technology Promotion Association (Thailand-Japan)	23MM331	7 Apr 23	5 Apr 24	-
3	Hot Air Oven		Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	21TM1409	19 Oct 22	18 Oct 23	-
4	Incubator	Total Coliform Bacteria Fecal Coliform Bacteria	Binder	BD 53 E2/ 13-07343	Technology Promotion Association (Thailand-Japan)	23TM192	15 Feb 23	14 Feb 24	-
5	Incubator		Memmert	IF 75 / D317.0305	Technology Promotion Association (Thailand-Japan)	23TM727	28 Apr 23	26 Apr 24	-
6	Water Bath		Memmert	IN 75 / D317.0307	Technology Promotion Association (Thailand-Japan)	23TM765	27 Apr 23	25 Apr 24	-
7	Water Bath		Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	23TM728	28 Apr 23	26 Apr 24	-
8	Analytical Balance		Ohaus	PX623 / C236754745	DKSH Technology Limited	C01223732	9 Dec 22	8 Dec 23	-
9	Auto Clave		ALP	CL-40L / 808	Technology Promotion Association (Thailand-Japan)	23TM763	27 Apr 23	25 Apr 24	-
10	Analytical Balance	Fat Oil & Grease	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-

List of Instrument/Equipment Certification for Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model / Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Laboratory Instrument/Equipments Water Quality Analysis.									
11	BOD Incubator	BOD	Arco	UC4-1320/ 13URC45013201	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
12	Digestor Unit	TKN	FOSS TECATOR	2520/ 91794469	National Food Institute, Ministry of Industry, Thailand	2302413-001	28 Mar 23	26 Mar 24	-
13	Distillation Unit (Kjeldahl Method)		FOSS TECATOR	KT8100 / 91889052	FOSS South East Asia	8411	29 May 23	27 May 24	-

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

Calibration Certificate

Certificate No.: 2302181-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhnong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Order No.: 2302181
Operation No.: 2302181-001
Date of Receipt: 14 March 2023
Date of Calibration: 24 March 2023

Calibrated by Mr.Pheraphat Tuanjit **Approved by** [Signature]
Scientist Specialist, Division of Calibration Laboratory
Date of Issue: 24 March 2023 **Responsible for the Technical Management Team**

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.

F-CS-009 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2302181-001-01
Equipment: pH Meter
Resolution: 0.01 pH : 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Type: Bench top

Date of Calibration: 24 March 2023 **Page 2 of 5**

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (23.4 ± 1.5) °C **Relative Humidity:** (52 ± 3) %
Condition of Equipment: Good Condition

Condition of this Results of Calibration

1. Calibration Method In house method : W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fuke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fuke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH003/17	PONPE	TE 650555-01	21 September 2023
Certified Reference Material				
	Lot No.	Manufacturer	Ref N	Expires Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH216.L5	18 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH217.L5	18 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH220.L5	18 February 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107.L5	16 February 2024

3. This certification is traceable to The International System of Unit (SI Unit)

- 3.1 Instruments No.2.1 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0008
- 3.2 Instruments No.2.2 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
- 3.3 Instruments No.2.3 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
- 3.4 Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
- 3.5 Certified Reference Material No.2.7 traceable to BIM Refn Hi-13 LoN 25.05.2022; BIM Refn Hi-16 LoN 02.06.2022; BIM Refn Hi-13 LoN 25.05.2022; BIM Refn Hi-16 LoN 02.06.2022, the Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

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

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

F-CS-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2302181-001-01
Equipment: pH Meter
Resolution: 0.01 pH : 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Type: Bench top

Date of Calibration: 24 March 2023 **Page 3 of 5**

Calibration Results:

1. Calibration of pH Meter (Manual Temperature Compensation at 25 °C)

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.120	414	0.00	0.58	2.00
2	295.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.000	0	7.00	0.58	2.00
8	-59.158	-59	8.00	0.58	2.00
10	-177.460	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.117	-414	14.00	0.58	2.00

2. Calibration of pH Meter with Electrode (Manual Temperature Compensation at 25 °C)

Equipment: pH Electrode **Type:** Combined Electrode
Manufacturer: METTLER TOLEDO **Model:** InLab Solids
Serial No.: 1156883 **ID No.:** N/A

Performance of Electrode system (Three-Point Calibration at pH 4, pH 7 and pH 10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	187	-	0.0071	2.00
6.865	6.86	22	97.86	0.0075	2.00
10.010	10.01	-160	97.86	0.0086	2.00
6.985	6.99	14	-	0.0093	2.00

F-CS-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2302181-001-01
Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C **Model:** SevenEasy pH
Serial No.: 1230525212 **ID No.:** UAE.WAS.003/2553
Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023 **Page 4 of 5**

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: Ambient Temperature 25 °C ± 1 °C
Relative Humidity 55 % ± 5 %

Condition of this results of Calibration:

- 1. Calibration Method : - In house method: W-TE-025 by comparison with standard thermometer.
- The Calibration is determined by comparing with a known temperature from a standard resistance thermometer.
- The temperature scale in use at this laboratory is the International Temperature scale of 1990 (ITS-90).

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1521	A85997	TE 660039-01	10-Dec-23	NATIONAL FOOD INSTITUTE
Platinum Resistance Thermometer (PRT)	385	509201			

Support Equipment : - Low Temperature Bath (ISOCAL-6), Model: Europa-6 Plus Basic, S/N: 341592/2

3. This certificate is traceable to International System of Units (SI Units).

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

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

6. Condition of Calibrated item : Good

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

F-CS-012 Revision: 01 Date: 20-04-65



Cert. No.: 22TM1490
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 55
Serial No. : B216.1666
ID No. : UAE.WAO.027/2559
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 19 October 2022
Calibration Date : 19 October 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hiahib
Approved by :
() Pornthippa Tameyakul
() Malee Butkruea
(✓) Suwit Imjai
Issue Date : 31 October 2022

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 & Equipment Calibration and Testing Services.

เอกสารไม่ควบคุม

A 0046800



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-05750C-1

Cert. No.: 22TM1490
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY41021843	22LM4	10 Jan 2023

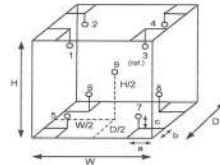
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm D = 0.33 m
b = 5.0 cm W = 0.40 m
c = 5.0 cm H = 0.40 m
Capacity = 0.053 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	29	30
REL.Humid. (%)	47	40
AC Supply (Volt)	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	(104) °C	(140,180) °C
1	18-04RTD-01	21-04TC-01
2	18-04RTD-02	21-04TC-02
3	18-04RTD-03	21-04TC-03
4	18-04RTD-04	21-04TC-04
5	18-04RTD-05	21-04TC-05
6	18-04RTD-06	21-04TC-06
7	18-04RTD-07	21-04TC-07
8	18-04RTD-08	21-04TC-08
9 (ref.)	18-04RTD-09	21-04TC-09

เอกสารไม่ควบคุม

a 1133252



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-05750C-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1490
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor *
104.0	104.0	104.0	0.061	1.3	1.7	0.42	2
140.0	140.0	140.0	0.14	2.3	2.4	1.1	2
180.0	180.0	180.0	0.21	3.5	3.6	1.3	2

Calibration Point (°C)	Measured Temperature (°C)								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.267	178.643	179.753	181.011	180.093	179.496	179.743	181.278

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location, which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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เอกสารไม่ควบคุม

a 1133251



Cert. No.: 23TM192
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Binder
Model : BD 53 E2
Serial No. : 13-07343
ID No. : UAE.MIC.005/2558
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory
Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Suwit Imjai
Approved by :
() Pornthippa Tameyakul
() Malee Butkruea
Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

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Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-4

Cert. No.: 23TM727
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

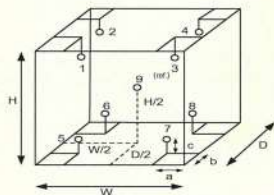
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	24
REL.Humid. (%)	76	80
AC Supply (Volt)	231	231



Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

D = 0.33 m
W = 0.40 m
H = 0.56 m
Capacity = 0.074 m³

เอกสารไม่ครบ



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & 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.: 23TM765
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator

Manufacturer : Memmert

Model : IN 75

Serial No. : D317.0307

ID No. : UAE.MIC.023/2561

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

Location : Microbiology Laboratory (302)

Received Order : 27 April 2023

Calibration Date : 27 April 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hiahhib

Approved by :

() Ponthippa Tameyakul
(/) Malee Bulkruea
() Suwit Imjai

Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ครบ



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-5
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM765
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
37.0	37.0	37.0	0.070	0.28	0.39	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
37.0	37.164	37.118	37.079	37.121	36.852	37.039	36.822	36.923	36.905	0.30

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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เอกสารไม่ครบ



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-5

Cert. No.: 23TM765
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

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

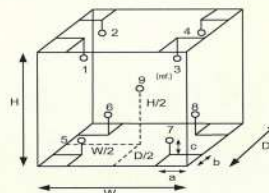
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	22
REL.Humid. (%)	69	73
AC Supply (Volt)	220	221



Position :	Ref. Std. ID No.:
1	20RTD-2/1
2	20RTD-2/2
3	20RTD-2/3
4	20RTD-2/4
5	20RTD-2/5
6	20RTD-2/6
7	20RTD-2/7
8	20RTD-2/8
9 (ref.)	20RTD-2/9

Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

D = 0.32 m
W = 0.42 m
H = 0.56 m
Capacity = 0.075 m³

เอกสารไม่ครบ



Cert. No.: 23TM728
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Memmert
Model : IPP 260
Serial No. : V616.0066
ID No. : UAE.MIC.032/2559
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (302)
Received Order : 27 April 2023
Calibration Date : 27 - 28 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Tawatchai Pama

Approved by :

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

Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-6
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM728
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
25.0	25.0	25.0	0.020	0.81	1.2	2
36.0	36.0	36.0	0.15	1.1	1.6	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
25.0	25.541	25.354	25.388	25.278	24.341	24.349	24.379	24.455	24.747	0.30
36.0	35.275	35.351	35.768	35.941	36.543	36.590	36.653	36.728	36.232	0.39

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-6
Procedure Used :-

Cert. No.: 23TM728
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OTD2 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

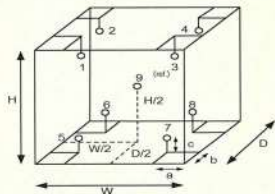
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	22
REL.Humid. (%)	76	83
AC Supply (Volt)	231	231



Probe Installation Details :

Dimension of Chamber :

a = 10 cm	D = 0.50 m
b = 10 cm	W = 0.64 m
c = 10 cm	H = 0.80 m
	Capacity = 0.26 m ³

Position :	Ref. Std. ID No.:
1	22-18RTD-2/1
2	18RTD-2/2
3	18RTD-2/3
4	18RTD-2/4
5	18RTD-2/5
6	18RTD-2/6
7	18RTD-2/7
8	18RTD-2/8
9 (ref.)	18RTD-2/9



Certificate of Calibration

Equipment: Balance
Model: PX623
Serial No. (or ID.): C236754745
Manufacturer: Ohaus
Condition: New

Certificate No.: C01223732
Issued Date: 09 December 2022
Job No.: KSPR2215576
Page: 1 of 2

Customer: United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Environment Condition: Temperature 26 °C ± 0.5 °C
Humidity 53 %RH ± 3.9 %RH

Calibration Place: United Analyst and Engineering Consultant Co., Ltd. (301 Microbiology Room)
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Calibration By: Mr. Adisai Maknoi
Calibration Date: 09 December 2022

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02221765

(Mr. Adisai Maknoi)

Person in charge

(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดิช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2639 7050 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

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CAL-FM-C01-14: 12 Sep 2022

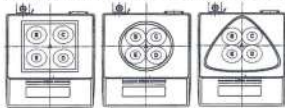
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Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.



Nominal Test Value		200			(g)
Reference Points (g)					
A	B	C	D	E	
-	0.000	0.000	0.000	0.000	

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
50	0.0004
500	0.0005

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0010	2.03
5	5.0001	5.000	0.000	0.0010	2.03
10	10.0001	10.000	0.000	0.0010	2.03
20	20.0001	20.000	0.000	0.0010	2.03
50	50.0001	50.000	0.000	0.0010	2.03
100	100.0001	100.000	0.000	0.0011	2.03
200	200.0004	200.000	0.000	0.0011	2.02
300	300.0005	300.000	-0.001	0.0013	2.01
400	400.0008	400.001	0.000	0.0014	2.01
500	500.0003	500.000	0.000	0.0017	2.00
600	600.0004	600.000	0.000	0.0019	2.00

The End of Certificate

Statements of conformity:

This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, UKAS Lab14. Therefore, those parameters have not been assessed separately.

Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :
- ☐ Choice A Binary Statement for Simple Acceptance Rule ($w = 0$), Specific Risk < 50% PFA.
 - ☒ Choice B Non-binary statement with guard band ($w = 1 U$), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.
 - ☐ Choice C Customer defined, Customers may define arbitrary multiple of r to have applied as guard band ($w = r U$).
- ; PFA – Probability of False Accept

(Mr. Rungrod Jenkitrakulchai)
Authorized signatory

Statements of conformity:

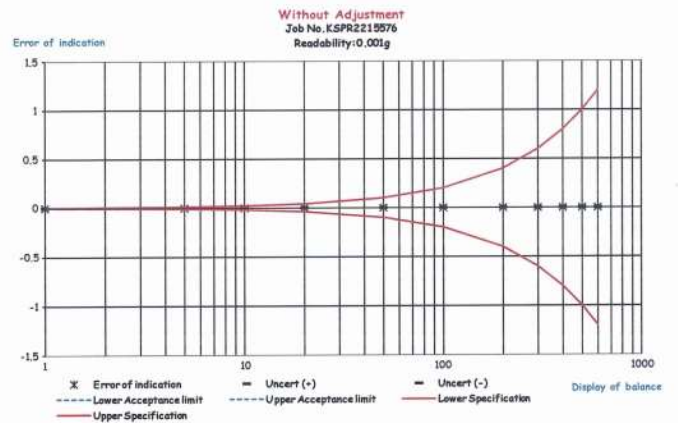
Without Adjustment

Readability: 0.001 g

Nominal Value (g)	Error of Indication (g)	Guard band (w) (g)	Tolerance (±) (g)	Conformity
1	0.000	0.0010	0.002	Pass
5	0.000	0.0010	0.010	Pass
10	0.000	0.0010	0.020	Pass
20	0.000	0.0010	0.040	Pass
50	0.000	0.0010	0.100	Pass
100	0.000	0.0011	0.200	Pass
200	0.000	0.0011	0.400	Pass
300	-0.001	0.0013	0.600	Pass
400	0.000	0.0014	0.800	Pass
500	0.000	0.0017	1.000	Pass
600	0.000	0.0019	1.200	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

The End of Statements of conformity





Cert. No.: 23TM763
Page : 1 of 3

Certificate of Calibration

Equipment : Autoclave
Manufacturer : ALP
Model : CL-40L
Serial No. : 808763
ID No. : UAE.MIC.026/2563
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (301)
Received Order : 27 April 2023
Calibration Date : 27 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hlahib
Approved by :
() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai
Issue Date : 11 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.

เอกสารไม่ควบคุม

A 0053944



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2304-0461OC-2
Procedure Used :-

Cert. No.: 23TM763
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

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

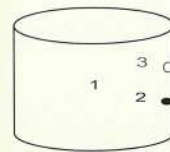
3. This certification is traceable to the International System of Unit.

4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3**

(** = Categorization of pathogens according to hazard and categories of containment, second edition, 1990)
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source



	Environmental		
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	27	60	220
Finished of Calibration	27	58	220

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	18-20TC-04
2 =	Temperature sensor	18-20TC-05
3 =	Exhaust port	18-20TC-06

เอกสารไม่ควบคุม

a 1159968



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2304-0461OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 23TM763
Page : 3 of 3

Operating parameter Set : Temperature = 115.0 °C
Sterilization period = 15 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
115.0	115.0	1	115.213	0.22	0.08	0.75	2
		2	115.166				
		3	115.260				

Operating parameter Set : Temperature = 121.0 °C
Sterilization period = 30 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
121.0	121.0	1	121.260	0.29	1.1	0.75	2
		2	121.224				
		3	121.284				

Average* : The average of 30 values in each position.

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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 %.

-000-

เอกสารไม่ควบคุม

a 1159967



Cert. No.: 23TM249
Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arco
Model : UC4-1320
Serial No. : 13URC4S013201
ID No. : UAE.WAO.015/2561
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hlahib

Approved by :
() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date : 24 February 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 0051476


 PASS
 NOT PASS

Remarks:

HPE: 20 ± 1°C
 (Signature)
 Verify Approve

Cert. No.: 23TM249

BOD Incubator

Arco

Model: UCA-1330

S/N: -

ID. No.: UAC.WAO.015(256)

17 Mar 2023 May 10, 2023
 02/17
 3 Apr. 167



Equipment : BOD Incubator
 Condition As-Received : Used Item
 Reference : 2302-0297OC-1
 Procedure Used :-

Cert. No.: 23TM249
 Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
 The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

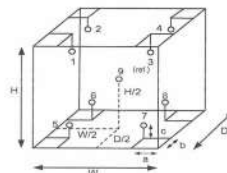
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	29	31
REL.Humid. (%)	63	67
AC Supply (Volt)	220	220



Probe Installation Details :

a = 10 cm
 b = 10 cm
 c = 10 cm

Dimension of Chamber :

D = 0.62 m
 W = 1.2 m
 H = 1.2 m
 Capacity = 0.89 m³

Position :	Ref. Std. ID No.:
1	22-18RTD-2/1
2	18RTD-2/2
3	18RTD-2/3
4	18RTD-2/4
5	18RTD-2/5
6	18RTD-2/6
7	18RTD-2/7
8	18RTD-2/8
9 (ref.)	18RTD-2/9



Equipment : BOD Incubator
 Condition As-Received : Used Item
 Reference : 2302-0297OC-1
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Not Available

Cert. No.: 23TM249
 Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
20.0	20.0	19.3	0.32	0.57	1.0	0.60	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.838	19.837	19.821	19.949

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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 %.

-000-

Verification Certificate

Certificate No.: 2302413-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment: HEATING BLOCK DIGESTION
Manufacturer: FOSS
Model: 2520
Serial No.: 91794469
ID No.: UAE.WAS.011/2560
Order No.: 2302413
Operation No.: 2302413-001
Date of Receipt: 28 March 2023
Date of Calibration: 30-31 March 2023

Calibrated by Mr.Nuttapol Niyomchat **Approved by** (Mr.Pheraphat Tuanjit)
Specialist Manager, Division of Calibration Laboratory
Date of Issue: 10 April 2023 Responsible for the Technical Management Team

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: 01 Date: 20-04-65

2008 ถนนสุขุมวิท 35 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10710 เอกสารไม่ควบคุม
2008 Soi 35, Asoi Asoi Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10710, Thailand
Tel: +66(0) 2422 8568 Fax: +66(0) 2422 8545 nfi.com

Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
Model: 2520 Serial No.: 91794469
Resolution: 1 °C ID No.: UAE.WAS.011/2560
Manufacturer: FOSS
Date of Calibration: 30-31 March 2023 Page 2 of 4

Location: Laboratory Room, NATIONAL FOOD INSTITUTE
Environment Condition: Ambient Temperature (25 ± 3) °C
Relative Humidity (55 ± 15) %
Line Voltage (220 ± 10) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert standard thermocouples type R into its heating block digestion compared to temperature obtained from reference standards thermometer at calibrated point.
- The temperature scale used was based on ITS - 90 .
- All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with Thermocouple	34970A	HY44045578/HY41194453	TC22/0044	5-May-2023	N.M. Technical Center Laboratory
	Type R	TC#181-189 / CH#181-189			

- This certificate is traceable to international system of units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC* Description
Time of Record : Hour 30 Minute At 380 °C

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

FCS-009 Revision: 01 Date: 20-04-65

Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
Model: 2520 Serial No.: 91794469
Resolution: 1 °C ID No.: UAE.WAS.011/2560
Manufacturer: FOSS
Date of Calibration: 30-31 March 2023 Page 3 of 4

Calibration point: 380 °C

Calibration result:

Reporting of Temperature

Block No.	UUC* Setting (°C)	UUC* Reading (°C)	Stability (±°C)	Standard Thermometer (°C)	Uncertainty (±°C)
1	380	380	0.96	377.74	2.1
2	380	380	0.40	377.28	2.1
3	380	380	1.18	377.82	2.1
4	380	380	0.44	377.19	1.6
5	380	380	0.11	377.30	1.6
6	380	380	0.14	377.90	1.6
7	380	380	1.17	373.85	2.1
8	380	380	0.33	376.96	2.1
9	380	380	0.14	374.18	2.1
10	380	380	0.96	378.56	2.0
11	380	380	1.04	378.34	2.0
12	380	380	0.35	378.06	2.0
13	380	380	0.48	377.05	1.6
14	380	380	0.38	379.19	1.6
15	380	380	0.50	377.48	1.6
16	380	380	0.48	378.33	1.7
17	380	380	0.71	377.60	1.7
18	380	380	0.35	376.77	1.7
19	380	380	0.84	377.06	1.8
20	380	380	0.41	378.58	1.8

Notes:

- UUC* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

FCS-009 Revision: 01 Date: 20-04-65

Kjeltec™ 8100 Distillation Unit

This IQ applies to Kjeltec™ 8100 Distillation Unit manufactured by FOSS Analytical. The installation is performed by FOSS trained service personnel.

1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical AB's Application Notes.

2 Purpose

This installation Qualification is designed to assure that:

- The Kjeltec instrument is received complete, with all required parts in good condition.
- The location of the instrument is environmentally and ergonomically suitable
- The instrument is assembled and configured correctly
- Suitable electricity and water are supplied to the instrument, see table 2 for requirements.

3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit	918 99052

Dedicated Analytical Solutions

FOSS Analytical AS
69 Slangerupgade
DK-3400 Hillerød
Denmark

Tel +45 7010 3370
Fax +45 7010 3371
E-mail support@foss.dk
Web www.foss.dk

FOSS Analytical AB
Box 79
SE-263 21 Högabäck
Sweden

Tel +46 42 361500
Fax +46 42 340345
E-mail support@foss.dk
Web www.foss.dk

Customer Support, 6003 7242 / Rev. 1

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4 Control of Received Equipment

4.1 Verify that the correct instrument type and accessory kit items are received and in proper condition

The packing list (shipped with the instrument) specifies all the items. The installer will verify that all items are received as shipped on the packing list. For each item listed, verify that the acceptance criteria are met. If so, write "Y" in the right column of the table immediately following.

Packing List Item	Acceptance Criteria	Pass(Y/N)
Kjeltec 8100 Distillation Unit	No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Accessory kit, according to packing list	Included. No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Handling device for digestion tube	Included. No visible damage.	Y
Tanks with level sensors for Waste, Alkali and Water	Included. No visible damage.	Y
Receiver flask	Included. No visible damage.	Y
One digestion tube 250ml	Included. No visible damage.	Y
One digestion tube 100 ml	Included. No visible damage.	Y
Tube adapter	Included. No visible damage.	Y
User manual	Kjeltec 8100 Distillation Unit	Y
Owners guide	Kjeltec 8100 Distillation Unit	Y
Quick guide	Kjeltec 8100 Distillation Unit	Y
Spare parts manual	Kjeltec 8100 Distillation Unit	Y
Application notes	AN 300 included AN 303 included	Y

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เอกสารไม่ควบคุม 200

5 Installation

5.1 The equipment must be installed in a suitable location with power, water and draining available

Verify that the instrument installation site meets the acceptance criteria given in the table below. If so, write "Y" in the right column of the table immediately following.

Location Requirements	Acceptance Criteria	Pass (Y/N)
Adequate space for instrument	Dimensions 48x58x69 cm	Y
AC supply available for instrument	200-240 V 50/60Hz	Y
Current	10 A	Y
Cold water supply available	2 L/min at 30°C	Y
Drain	For cooling water and waste (depending on local waste disposal legislation)	Y
Ambient temperature	Max. 40°C	Y
Ambient humidity	Max. 80% relative	Y
Internal fuses	T10A AH	Y

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เอกสารไม่ควบคุม 300

5.2 The instrument must be assembled correctly

Verify that all tubes are correct connected. If so, write "Y" in the right column of the table immediately following.

Instrument Tubing Connections	Acceptance Criteria	Pass (Y/N)
	Visual verification by installer	Y

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5.3 The instrument should be assembled and powered up

Connect the distilling unit to the power supply. Perform the start up procedure and check that the expected response is obtained. If so, write "Y" in the right column of the table immediately following.

Action	Expected Response	Pass (Y/N)
Switch on the power	The instruments start up and the self test will run. The sample counter shows the number of analysed samples since first power and the Software Version shows the version of the instruments software.	Y
	After start-up, Program 1 is loaded and the Analyse menu is displayed.	Y
Turn on the cold water tap	No visible reaction	Y
Press the "Manual" view	The Manual menu is opened	Y
Open the door with the handle, place the test tube and receiver flask in position. Close the door.		Y
Select Dilution and press Start	Water is added to the tube	Y
Select Alkali and press Start	Alkali is added to the tube	Y
Select Steam and press start	After heating up, steam is entering the tube	Y
Select Drain and press Start	The tube is drained	Y

6 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

7 IQ Documentation

Upon successful completion and recording of all instructions above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Installed By: _____
 Company: _____
 Customer Name: _____
 Company: _____
 Date completed: _____



Kjeltec™ 8100 Distillation Unit

This OQ applies to Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The operation qualification is performed by FOSS trained service personnel.

1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical Application Notes.

2 Purpose

This procedure is designed to test the function of the instrument according to factory test specifications:

- Alkali volume
- Distillation Accuracy
- Distillation Repeatability

3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit, 200-240 V 50/60 Hz	91869052

4 Performance

4.1 Verify the dispensed volumes of reagents

Note! To verify the dispensed volumes of reagents a triple test should be done to be statistic correct. Then calculate a mean value.

1. Choose "Manual" in the menu. (When starting up the instrument Program 1 is loaded)
2. Open the safety door by pressing **Open** and place a tube in the instrument. Close the safety door.

Water

1. Press **Dilution** and then press **Start**. 80 ml of water will be filled into the tube.
2. Measure the collected water in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Note! If the water volume needs to be calibrated, go to 4.8.5 Dilution Pump Calibration in the User Manual.

Alkali

1. Press **Alkali** and then press **Start**. 50 ml of alkali will be filled into the tube.
2. Measure the collected alkali in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Table 1 Volume control

Test	Result	Expected result	Passed (Y/N)
Water volume	83 ml 83 ml 81 ml Mean 82.67 ml	76- 84 ml	Y
Alkali volume	52 ml 52 ml 53 ml Mean 52.33 ml	47- 54 ml	Y

Dedicated Analytical Solutions

FOSS Analytical A/S
 69 Slangerupgade
 DK-3400 Hillerød
 Denmark

Tel +45 7010 3370
 Fax +45 7010 3371
 E-mail support@foss.dk
 Web www.foss.dk

FOSS Analytical AB
 Box 70
 SE-263 21 Höganäs
 Sweden

Tel +46 42 361500
 Fax +46 42 340349
 E-mail support@foss.dk
 Web www.foss.dk

4.2 Verify the distillation procedure, accuracy and precision

The distillation principle is to convert ammonium (NH_4^+) into ammonia (NH_3) by using an alkali (NaOH) and thereafter steam distil it into a receiver flask containing boric acid and titrate with standard acid solution using colorimetric end-point detection. Ammonium sulphate, a substance with known ammonia content, can be used to check the accuracy of the distillation. The recovery is calculated from obtained result.

The way to perform this test will be described in the following.

Chemical Check

Use ammonium sulphate ($\text{NH}_4)_2\text{SO}_4$, purity > 99.5 % *)

Mol. weight = 132.14 g/mol, Nitrogen content in ammonium sulphate (99.5 %) = 21.09% *)

Analysis conditions according to AN 300

Water	80 ml
Alkali	50 ml NaOH (40%w/w)
Receiver solution	30 ml boric acid (4%)
Distillation time	5 minutes
SAFE	5 seconds
Titration	0.2N HCl

For reagent preparation see Appendix A

- Start the instrument and run two blanks without chemicals according to above analysis conditions, distil into a receiver flask containing boric acid. Titrate with a standard acid solution using colorimetric end-point detection. If the blanks are less than 0.2 ml continue with the recovery tests:
- Weigh 0.15 g ammonium sulphate into a tube. Prepare 6 samples (tubes).
- Run the six samples according to above analysis conditions. Titrate with a standard acid solution using colorimetric end-point detection.
- Calculate the recovery according to below equations. Expected results of recovery should be 100%±1%.

Recovery test	Result	Expected result	Passed (Y/N)
Blank value (water blank)	1. 0.03 ml 2. 0.14 ml	0.05-0.20 ml	Y
Recovery	1. 100.5% 2. 100.3% 3. 100.6% 4. 99.8% 5. 99.9% 6. 100.0%		
Accuracy	Mean Value: 100.0%	99-101%	Y
Precision	SD: 0.55%	SD <1%	Y

Customer Support, 6003 7246 / Rev. 1

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*) Note! Please also note that the below calculations must be adjusted if other purity levels of ammonium salts are used. A certificate for the chemical supplier should be available

Purity	Nitrogen content
99.5%	21.09%
99.6%	21.12%
99.7%	21.14%
99.8%	21.16%
99.9%	21.18%

$$\% \text{ Nitrogen} = \frac{(ml_{\text{sample}} - ml_{\text{blank}}) \times N \times 14,007 \times 100}{mg_{\text{sample}}} \quad 0.1095 \quad 21.72$$

N = Normality of titrant to 4 places of decimal.

$$\% \text{ Recovery} = \frac{\% \text{ Nitrogen}}{21.09} \times 100$$

mg sample

① 0.159 g 23.56

②

③

④

⑤

⑥

5 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

6 OQ Documentation

Upon successful completion of tests above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Performed By: _____

Company: _____

Customer Name: _____

Company: _____

Date completed: _____

Customer Support, 6003 7246 / Rev. 1

เอกสารไม่ควบคุม

3(7)

7 Appendix A

7.1 Preparation of Reagents

7.1.1 Alkali

To convert ammonium into ammonia an excess of sodium hydroxide is necessary.

Use 400 g NaOH per litre of solution. Commercially available in concentrations up to 50 %. Do not use concentrations above 40 % as this will lead to crystal formation impairing the function of the pumps. If you can only buy concentrations > 40 %, dilute it before use.

7.1.2 Titrant acid, determination of concentration

To be able to achieve accurate nitrogen / protein results, one must be quite sure that the HCl (hydrochloric acid) concentration is what it is supposed to be. A titration against a predetermined solution of sodium carbonate as described below is thus necessary. Incorrect HCl concentration can otherwise cause substantial errors.

- Standard substance**
Weigh approx. 10 g of anhydrous sodium carbonate (Na_2CO_3). Use a mortar to make a fine powder. Dry it for 1 h at 265 °C or 2 h at 200 °C. After cooling in a desiccator, transfer the sodium carbonate to a beaker with a tight lid. Store it in a desiccator.
- Indicator solutions**
Dissolve 0.1 g methyl red in 100 ml methanol. Dissolve 0.1 g bromocresol green in 100 ml methanol.
- Procedure**
Weigh approx. 0.4 g of the standard substance, using an analytical balance, note the weight (W_1). Transfer the sodium carbonate to a receiver flask and add 40 ml of H_2O (distilled or deionized). Add 8 drops from each of the indicator solutions. Titrate to pink. Note the amount in ml used (A_1). Boil this solution for a few minutes. The solution will turn green. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour change occurs. Note also this volume (A_2). Boil the solution for a few minutes. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour occurs. Note also this volume (A_3).
Note! Temperature changes will influence the volume and the concentration of the titrant solution. The working temperature of the titrant should approximate that of its temperature during standardization. If temperature corrections are necessary, sufficient accuracy may be obtained by use of a correction table. (AOAC 942.25)

Customer Support, 6003 7246 / Rev. 1

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3(7)

7.2 Calculation

$$\text{Molarity (M)} = \frac{18,870 \times W_1}{(A_1 + A_2 + A_3)}$$

Note! Concentration must be accurate to four digits, i.e. 0.2000 M.

Note! The colour change of this official procedure (AOAC 936.15) may be difficult to see, therefore a pH meter or a mixed indicator (e.g. 0.1 g Methyl red and 0.1 g Bromocresol green in 100 ml methanol) will make it much easier to perform.

7.3 Receiver Solution

Boric acid 4 % with bromocresol green / methyl red indicator solution

In order to obtain accurate results the receiver solution is adjusted so that a small (0.05-0.20 ml) positive blank is obtained when running a blank sample. The 4 % boric acid receiver solution is prepared by dissolving 400 g of boric acid in about 5-6 l very hot deionized water. Mix and add more hot deionized water to a volume of about 9 l. Cool the solution to room temperature and add 100 ml of bromocresol green solution (100 mg in 100 ml methanol) and 70 ml of methyl red solution (100 mg in 100 ml of methanol). Dilute to 10 l with deionized water and mix carefully.

Note! The addition of alkali is to achieve a positive blank value. This should, however, be kept between 0.05 - 0.20 ml titrant, to obtain good repeatability when testing blanks.

Adjustment of the boric acid is made by the following procedure:

1. Transfer 25 ml boric acid solution to a receiver flask and add 100 ml of distilled water. If the solution in the flask is still red, titrate with 0.1 M sodium hydroxide solution until a neutral grey colour is obtained. Calculate the amount of sodium hydroxide solution necessary to adjust the boric acid solution in the 10 l flask with the formula: ml 1.0 M alkali = ml titrant x 40
2. Add the calculated amount of 1.0 M alkali solution to the boric acid solution. Mix.
3. To check proceed as follows using 25 ml of the boric acid solution. Run a blank. If the value of this blank is high (0.5 ml of 0.2 M HCl) the boric acid is incorrectly adjusted. This might create irregular blanks. For correction add HCl directly into the boric acid tank, mix it carefully and repeat until a reading of 0.05 - 0.20 ml HCl is obtained. If a positive blank is not achieved, add further small quantities of 1 M NaOH and repeat the check until a satisfactory value is achieved.

4.2 Ongoing Qualification Tests

Block Temperature

The temperature for the digestion is limited by the boiling point for the sulphuric acid, this can be increased by adding a salt (K_2SO_4) to the digestion mixture. It's important that the optimal ratio between acid and salt is kept; please follow recommendation in AN 300 or suggested procedures for a specific kind of sample material.

The block temperature itself can be controlled external by inserting a temperature probe in the intended hole in the aluminium block (front row of holes).

Use the reagents and method procedure specified in AN 300. Use only reagents of recognized analytical grade, unless otherwise specified and distilled or demineralised water or water of equivalent purity.

Suggested standard material for internal quality control:

Ammonium sulphate $[(NH_4)_2SO_4]$, min. 99.5 % (mass fraction), with certified purity.

Note: The above chemical is usually readily available with a certificate specifying the purity.

Alternatively ammonium iron(II) sulphate, $(NH_4)_2 Fe (SO_4)_2 \times 6 H_2O$, with certified purity may be used.

Tryptophan ($C_{11}H_{12}N_2O_2$), minimum assay 99 % (mass fraction). Nitrogen content 137.2 g/kg. Do not dry in an oven before use.

Acetanilide (C_8H_9NO), minimum assay 99 % (mass fraction). Nitrogen content 103.6 g/kg. Do not dry in an oven before use.

Sucrose, ($C_{12}H_{22}O_{11}$), with a nitrogen content of not more than 0.002 % (mass fraction). Do not dry in an oven before use.

Blank Tests

Carry out a blank test following the currently used procedure for digestion, distillation and titration taking 2 ml of water and about 0.7 g of sucrose instead of the test portion. Keep a record of blank values. If blank values change, identify the cause.

Note: The amount of titrant used in the blank test should always be greater than 0.0 ml. Blanks within the same laboratory should be consistent across time.

4.3 Recovery Tests

Regularly run recovery studies to check the accuracy of procedure and equipment:

- **Nitrogen loss.** - Use 0.12 g ammonium sulphate and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Add all other reagents as stated in the method currently used (Kjeltabs, H_2SO_4 , etc). Digest and distil under same conditions as for sample. Recoveries shall be >99 %.
- **Digestion efficiency.** - Use a test portion of minimum 0.15 g of tryptophan or acetanilide and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Determine the nitrogen content according to the current procedure in use. The recoveries of tryptophan shall be >98.5 %; the recoveries of acetanilide shall be >99.5 %.
- **Distillation and titration efficiency.** - Distil 0.10 - 0.15 g ± 0.0001 g ammonium sulphate, omitting the digestion step. The recoveries should be >99.5 %.

Note: Results less than 98.5 % or more than 101.0 % in either of the recovery tests indicate failures in the procedure and/or inaccurate concentration of the standard volumetric hydrochloric acid solution (should be adjusted to four decimals accuracy according to procedure in AN 300)

Kjeltec™ 8100 Distillation Unit Tecator™ 2508/2520 Digestor

1 Scope

This PQ applies to the Digestion system 2508/2520 (including exhaust and scrubber unit) and Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The user of the instrument performs the PQ.

2 Intended Use

The Digestion system (including exhaust and scrubber) and Kjeltec 8100 Distillation Unit are intended for laboratory use analyzing parameters as specified in FOSS Application Notes.

3 Purpose

The guidelines are intended to assist the user in successfully developing Performance Qualifications for the specific application(s) to which the instrument is applied.

The Performance Qualification (PQ) includes the process of demonstrating that the Digestion system 2508/2520 (including exhaust and scrubber unit) and the Kjeltec 8100 Distillation unit consistently perform according to a specification appropriate for its routine use. Main activities in the PQ phase are:

- Preventive maintenance
- On-going verification tests

This document suggests routines to fulfill the requirements for an acceptable PQ but the final procedure should be adapted to local routines for similar equipment.

4 Definition of Test Procedures

4.1 Preventive Maintenance

Maintenance of the Kjeltec 8100 should be performed according to the instructions in manual, see User Manual Kjeltec 8100/8200 Distillation Unit, chapter 5. Maintenance. A yearly service is recommended (service agreement).

Maintenance of the Digestion block (including exhaust and scrubber) should be performed according to instruction in the user manual, see User Manual Tecator Digestor, chapter 5. Maintenance.

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Box 70
SE-263 21 Höganäs
Sweden

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Fax +46 42 340349
E-mail support@foss.dk
Web www.foss.dk

External Quality Control Program

It is recommended to participate in an external quality control program, such a proficiency program or ring test, with equivalent sample material as analysed within the laboratory.

Calculation and Expression of Results

$$W_N = \frac{14.007(V_s - V_b)N \times 100\%}{m}$$

Where:

W_N is the nitrogen content of the sample, expressed as a percentage by mass.

V_s is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the sample test, in milliliters, expressed to the nearest 0.05 ml.

V_b is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the blank test, in milliliters, expressed to the nearest 0.05 ml.

N is the numerical value of the exact normality of the hydrochloric acid standard volumetric solution, expressed to four decimal places.

m is the numerical value of the mass of the test portion, in milligrams, expressed to the nearest 1 mg for sample weights >1 g or to the nearest 0.1 mg for sample weights <1 g.

5 Maintenance

5.1 Maintenance Kjeltec™ 8100

See instructions in User Manual - Kjeltec 8100/8200, chapter 5 Maintenance.

5.2 Maintenance Tecator™ Digestor

See instructions in User Manual - Tecator Digestor, chapter 5 Maintenance.

6 The Maintenance Record Charts

This record charts are provided to assist you in keeping your system in good working order. Please make copies and use them regularly as they can often help us to help you in the unlikely event a system malfunction.

6.2 FossCare™ Customer Log

6.2.1 Daily Maintenance

[illegible]

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6.1 FossCare™ Service Log

[illegible]

เอกสารไม่ควบคุม

6.2.2 Weekly Maintenance

[illegible]

เอกสารไม่ควบคุม

Applicable for FOSS sales and service companies.

6.2.5 Yearly Maintenance

[illegible]

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6.2.3.3 Every 1-3 Months Maintenance

[illegible]

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6.2.6 Exchange of Parts and Reagents Maintenance

[illegible]

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6.2.4 Additional Maintenance

[illegible]

เอกสารไม่ควบคุม

เอกสารสอบเทียบเครื่องมือ
ประจำเดือนตุลาคม พ.ศ. 2566

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)	Thermo Scientific	G25A 158M	Tisch Environmental,Inc.	05072023	5 Jul 23	4 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1400	9 May 23	8 May 24	-
3	Air Flow Meter	Particular Matter (PM _{2.5})	Mesa Labs	DeltaCal DC1 155894	Innovative Instrument Co.,Ltd.	22-AFM-173	31 Oct 22	30 Oct 23	-
4	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1859	2 Jun 23	1 Jun 24	-
5	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1200	5 Jun 23	5 Jun 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22177051	UAE Consultant Co.,Ltd.	22022023	22 Feb 23	21 Feb 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22387035	UAE Consultant Co.,Ltd.	09012023	9 Jan 23	8 Jan 24	-
8	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NP99E15A01D3	21 Jun 21	21 Jun 24	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43C 0517512003	UAE Consultant Co.,Ltd.	19042023	19 Apr 23	18 Apr 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i CM22387061	UAE Consultant Co.,Ltd.	17012023	17 Jan 23	16 Jan 24	-
11	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NP99E15A01D3	21 Jun 21	21 Jun 24	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
12	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1200636465	UAE Consultant Co.,Ltd.	20032023	20 Mar 23	19 Mar 24	-
13	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1200636467	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
14	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
15	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORBA	APHA-370 RTHK2PDH	UAE Consultant Co.,Ltd.	08022023	8 Feb 23	7 Feb 24	-
16	Total Hydrocarbons Analyzer	Total Hydrocarbons	HORBA	APHA-370 93JN1MN9	UAE Consultant Co.,Ltd.	15022023	15 Feb 23	14 Feb 24	-
17	Standard Gas	Total Hydrocarbons	Air Liquide	CC143232	Air Liquide	E03Al99E15A006C	16 Oct 20	16 Oct 28	-
18	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM13368	Calibration Laboratory Co.Ltd	Q23015868	13 Feb 23	12 Feb 24	-
19	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35A 73249	Innovative Instrument Co.,Ltd.	23-ACT-111	27 Jun 23	26 Jun 24	-
20	Sound Level Meter	$L_{Aeq, 24\text{ hours}}$ L_{Amax} เสียงรบกวน	Larson Davis	LxT1 0007303	Larson Davis-A PCB Piezotronics Div.	2023003660	23 Mar 23	22 Mar 25	-
21	Sound Level Meter	$L_{Aeq, 24\text{ hours}}$ L_{Amax} เสียงรบกวน	Larson Davis	LxT1 0007304	Larson Davis-A PCB Piezotronics Div.	2023003661	23 Mar 23	22 Mar 25	-

Certificate of Calibration

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

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

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

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

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

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

Tisch Environmental, Inc.
145 South Miami Avenue
Village of Cleves, OH 45002

www.tisch-env.com
TOLL FREE: (877)263-7610
800-777-9009
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5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL: 0-2717-3000-24 FAX: 0-2719-9484

Certificate of Calibration

Certificate No.: 23P1400
Page: 1 of 2

Equipment: U-Tube Manometer
Manufacturer: Dwyer
Model: 1221-36-W/M
Serial No.: -
ID No.: UAE.EFM.020/2560

Condition As-Received: Used Item

Received Date: 26 April 2023
Calibration Date: 09 May 2023

Reference: 2304-0703WSC

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

Ambient Temperature: (23 ± 2) °C

81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,

Relative Humidity: (50 ± 15) %

Phrakhanong, Bangkok 10260

Atmospheric Pressure: 1010 mbar

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0137-22	24 Aug 2023

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

3. Scale and conversion factor is 1 kPa = 4.0146293 inH2O

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

5. This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.

6. This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Suwit Aussarree
Issue Date: 11 May 2023

Approved Signatory:
[Signature]
[Signature]
[Signature]
[Signature]

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0314240

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/101 MOO 13, SOI SUKUNAKORN 11 TAMBON BANG KHAO,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0660-2116-5800-1 FAX: 0660-2116-7540



Certificate of Calibration

Customer: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD. Certificate No.: 22-AFM-173

Name: Request No.: Req-2022-1865

Address: 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260

Unit Under Calibration Details

Measurement Item: Air Flow meter

Sensor Model: -

Manufacturer: BGI

Sensor Serial Number: -

Model: Delta Cal DC1

Serial Number: 155894

ID: UAE.EFM.075/2560

Location of Calibration: LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature: 23 °C ± 3 °C

Humidity: 55 %RH ± 20 %RH

Barometric Pressure: 1013 kPa ± 10 kPa

Received Date: 12 October 2022

Calibration Date: 31 October 2022

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gillibrator 7 High Flow	1850101202	Sensodyne	15 June 2023

Traceability:

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

Note:

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

Calibration By:
[Signature]
Mr. Noppasit Luangert
Service Calibration Engineer

Approved By:
[Signature]
Mr. Pichai Muthavorn
Calibration Engineer Supervisor
Issue Date: 31 October 2022

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

FM-708-AFM-01 Rev.00 Issue date 01/07/19

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1160341

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Certificate No : 22-AFM-173
Request No : Req-2022-1865

Result of Calibration :

Flow Setting	STD Flow Reading	UUC Flow Reading	Correction Flow	Uncertainty
(LPM)	(LPM)	(LPM)	(LPM)	(LPM)
14.5	14.50	14.57	-0.07	0.21
15.0	15.01	15.09	-0.08	0.22
15.8	15.80	15.87	-0.07	0.23
16.6	16.59	16.64	-0.05	0.24
18.3	18.30	18.36	-0.06	0.26

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

End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev.00 Issue date 01/07/19

เอกสารไม่ควบคุม

Certificate of Calibration

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

Certificate No : 22-TPM-429
Request No : Req-2022-1865
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 155894
Resolution : 0.1 °C
ID Number : UAE.EFM.075/2560

Range Calibration : 20 °C to 45 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 3
Calibration Position (mm) : 45
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 12 October 2022
Calibrated Date : 31 October 2022
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

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

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

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

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 31 October 2022

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

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Calibration Note
UUC Adjustment : Not Adjust

Certificate No : 22-TPM-429
Request No : Req-2022-1865
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
Ta	20.003	20.0	0.0	0.14
	25.004	25.0	0.0	0.14
	30.003	30.0	0.0	0.14
	35.003	35.1	-0.1	0.14
	40.003	40.1	-0.1	0.14
	45.003	45.1	-0.1	0.14
TT	20.003	20.0	0.0	0.14
	25.004	25.0	0.0	0.14
	30.003	30.0	0.0	0.14
	35.003	35.0	0.0	0.14
	40.003	40.0	0.0	0.14
	45.003	45.0	0.0	0.14

End of Certificate

Calibrated By : 
Mr. Noppadol Luangrat

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL: 0-2717-3880-24 FAX: 0-2710-9484



Certificate of Calibration

Certificate No. : 23P1859
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer : Barigo
Model : -
Serial No. : -
ID No. : UAE.ANV.123/2550

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.

Condition As-Received: Used Item
Received Date : 26 May 2023
Calibration Date : 02 June 2023

Reference: 2305-0919WSG
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1007 mbar

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

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

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

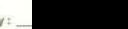
Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP142	1422505046	MP-0094-23	03 May 2024

2. This instrument was installed in vertical orientation and center of the dial was used as the reference level.
3. This result of calibration was made on requested at the point specified by customer.
4. This result of calibration instrument was in absolute pressure.
5. This instrument was used clean air as pressure media.
6. The certificate is valid only to the item calibrated on date and place of calibration.
7. This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew
Issue Date : 08 June 2023

Approved Signatory : 
[] Phalinee Prapapais
[] Sura Suwannasri
[x] Atapol Panurech

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-TPM-01 Rev.01 Issue date 13/02/20

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B 0316959



Cert.No.: 23P1859
Page: 2 of 2

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

Range: 960 hPa to 1030 hPa
Scale Interval: 1 hPa (The Fifth Estimate)

Increasing Pressure

Applied Pressure (hPa)	958.80	969.94	981.10	991.92	1003.33	1013.39	1024.48	1035.27
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	1.20	0.06	-1.10	-1.92	-3.33	-3.39	-4.48	-5.27

Decreasing Pressure

Applied Pressure (hPa)	1035.27	1023.97	1013.46	1003.54	992.07	981.34	970.00	959.03
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-5.27	-3.97	-3.46	-3.54	-2.07	-1.34	0.00	0.97

The uncertainty of measurement was ± 0.30 hPa

* UUC = Unit Under Calibration

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

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a 1165505



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10258
TEL. 0-2717-3000-34 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23H1200
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.ANV.130/2550

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023

to 06 June 2023

Reference: 2305-0919WSC

Ambient Temperature: (25 \pm 3) °C

Relative Humidity: (50 \pm 20) %

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.

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

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

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

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	23105	15 Mar 2024

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

3. This Certificate is traceable to the International System of Unit maintained through:-

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

-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by: Somchai Dumwor
Issue Date: 07 June 2023

Approved Signatory:

[] Chakrit Waeewanjua
[] Pornthippa Tameyakul
[] Viporn Tantiyawutti

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B 0316274



Cert. No.: 23H1200
Page: 2 of 2

Result of Calibration:-

Function: Humidity Measurement

Before Adjustment

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	48	7.9	1.6
25.0	60.0	63	3.0	1.7
25.0	80.0	76	-4.0	1.9

Result of Calibration:-

Function: Humidity Measurement

After Adjustment

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	44	3.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	75	-5.0	1.9

Result of Calibration:-

Function: Temperature Measurement

Without Adjustment

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (\pm °C)
19.987	20.0	0.013	0.72
30.016	30.0	-0.016	0.72
39.944	39.5	-0.444	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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a 1165295



United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phraekhanong, Bangkok 10260
Tel. 0 2763 2828 Fax 0 2763 2800 www.uaecconsultant.com E-mail: uaec@uaecconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date: Feb 22, 2023

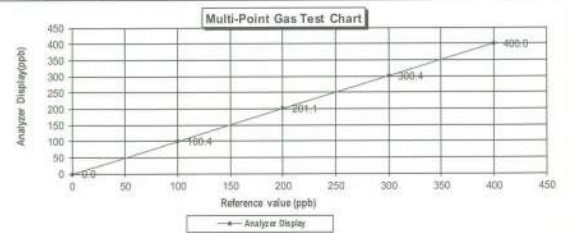
Equipment: Gas Analyzer (NO₂) Model: 421
Manufacturer: Thermo Scientific Serial Number: CM22177051

Standard Gas Concentration

Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer:	Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model:	1461
Methane (CH ₄)	-	PPM	Serial Number:	1180540071
Carbon Monoxide (CO)	984.8			
Cylinder No.:	EB0143262			
Expiration Date:	Jun 21, 2024			

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	0.40	0.40	0.40
Level 3 40.00%	200.0	1.10	0.55	0.55
Level 4 60.00%	300.0	0.40	0.13	0.13
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark: Measuring Range	500.0 ppb		Average Difference (%)	0.22
	Acceptable Limit $\pm 5\%$			



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MULTI-POINT GAS TEST REPORT

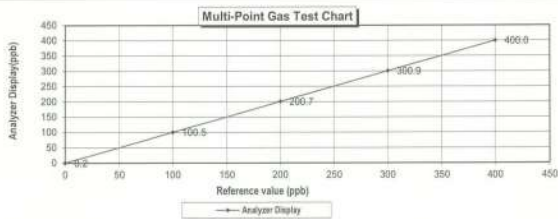
Test Date : Jan 9, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : CM22387035

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model : 146i
Methane (CH ₄)	-	PPM	Serial Number : 1180540071
Carbon Monoxide (CO)	984.8		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 21, 2024		

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.20	0.20	0.20
Level 2 20.00%	100.0	0.50	0.50	0.50
Level 3 40.00%	200.0	0.70	0.35	0.35
Level 4 60.00%	300.0	0.90	0.30	0.30
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range		Average Difference (%)		0.27
: Acceptable Limit $\pm 5\%$				



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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
(Do Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals)

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

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708008	48.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	DS85025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423836102	CC505981	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14080119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

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

Triad Data Available Upon Request

NOTES: PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



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

Approved for Release



CERT 3082.01

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MULTI-POINT GAS TEST REPORT

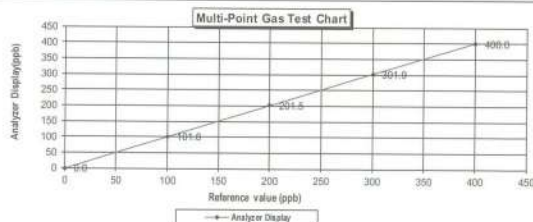
Test Date : Apr 19, 2023

Equipment : Gas Analyzer (SO₂) Model : 43C
Manufacturer : Thermo Electron Corporation Serial Number : 0517512003

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

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	101.8	1.77	1.77
Level 3 40.00%	200.0	201.5	1.74	1.74
Level 4 60.00%	300.0	301.9	0.63	0.63
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range		Average Difference (%)		0.63
: Acceptable Limit $\pm 5\%$				



Calculate by

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MULTI-POINT GAS TEST REPORT

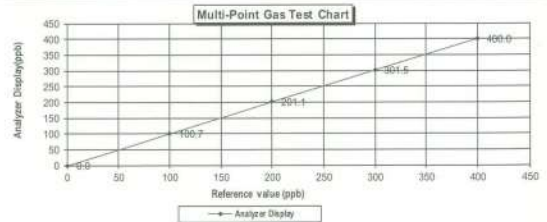
Test Date : Jan 17, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : CM22387061

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

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	100.7	0.70	0.70
Level 3 40.00%	200.0	201.1	1.10	0.55
Level 4 60.00%	300.0	301.5	1.50	0.50
Level 5 80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range		Average Difference (%)		0.35
: Acceptable Limit $\pm 5\%$				



Calculate by

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 650
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600R-12/931, 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.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
NITRIC OXIDE	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.0% NIST Traceable	09/14/2021, 09/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	09/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC708098	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D85025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505681	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

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



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

Approved for Release



CERT 3082.01

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MULTI-POINT GAS TEST REPORT

Test Date : Mar 20, 2023

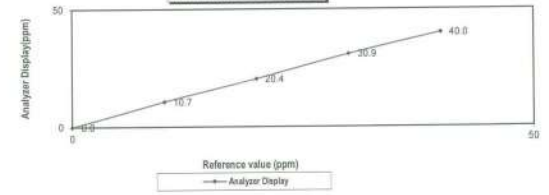
Equipment : Gas Analyzer (CO) Model : 48i
Manufacturer : Thermo Scientific Serial Number : 1200636465

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 20, 2024	

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.0	0.0	0.0
Level 2 20.00%	10.0	10.7	0.7	6.5
Level 3 40.00%	20.0	20.4	0.4	2.0
Level 4 60.00%	30.0	30.9	0.9	2.9
Level 5 80.00%	40.0	40.0	0.0	0.0
Remark : Measuring Range	50.0 ppm		Average Difference (%)	2.28
			Acceptable Limit ± 5%	

Multi-Point Gas Test Chart



Calculate by

Page 1 of 1

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MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

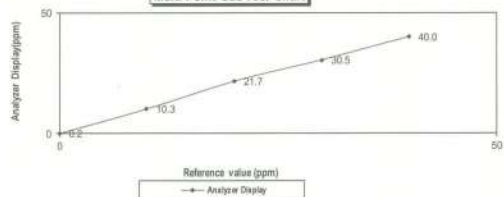
Equipment : Gas Analyzer (CO) Model : 48i
Manufacturer : Thermo Scientific Serial Number : 1200636467

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 20, 2024	

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.2	0.2	0.2
Level 2 20.00%	10.0	10.3	0.3	2.9
Level 3 40.00%	20.0	21.7	1.7	7.8
Level 4 60.00%	30.0	30.5	0.5	1.6
Level 5 80.00%	40.0	40.0	0.0	0.0
Remark : Measuring Range	50.0 ppm		Average Difference (%)	2.52
			Acceptable Limit ± 5%	

Multi-Point Gas Test Chart



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 650
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600R-12/931, 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.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
NITRIC OXIDE	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	09/14/2021, 09/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.0% NIST Traceable	09/14/2021, 09/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	09/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20081120	CC708098	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D85025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505681	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

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



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

Approved for Release



CERT 3082.01

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MULTI-POINT GAS TEST REPORT

Test Date : Feb 8, 2023

Equipment : Hydrocarbon Analyzer Model : APHA-370
Manufacturer : HORIBA Serial Number : RATFBXS

Standard Gas Concentration

Sulphur Dioxide (SO₂) : PPM
Nitric Oxide (NO) : PPM
Methane (CH₄) : 39.8 PPM
Carbon Monoxide (CO) : PPM
Cylinder No. : D824432
Expiration Date : Aug 4, 2028

Dilutor Detail

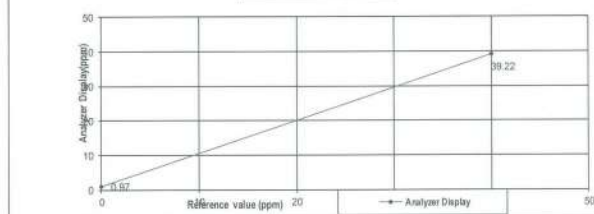
Manufacturer :
Model :
Serial Number :

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.00	0.97	0.97	0.97
Level 2 80.00%	40.00	39.22	-1.99	1.99
Remark : Measuring Range	50.00 ppm	Average Difference (%)	1.48	

Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



Page 1 of 1

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MULTI-POINT GAS TEST REPORT

Test Date : Feb 15, 2023

Equipment : Hydrocarbon Analyzer Model : APHA-370
Manufacturer : HORIBA Serial Number : 933N1MN9

Standard Gas Concentration

Sulphur Dioxide (SO₂) : PPM
Nitric Oxide (NO) : PPM
Methane (CH₄) : 39.8 PPM
Carbon Monoxide (CO) : PPM
Cylinder No. : D824432
Expiration Date : Aug 4, 2028

Dilutor Detail

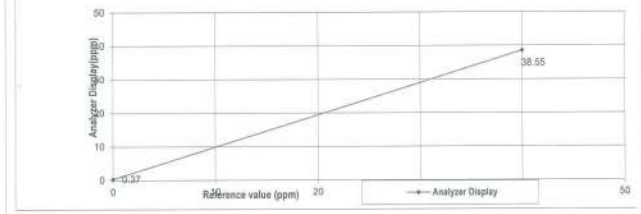
Manufacturer :
Model :
Serial Number :

Multi-point gas test data

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.00	0.37	0.37	0.37
Level 2 80.00%	40.00	38.55	-1.45	3.76
Remark : Measuring Range	50.00 ppm	Average Difference (%)	2.07	

Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



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Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 1
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E03A199E15A006C Reference Number: 160-401908379-1
Cylinder Number: CC143232 Cylinder Volume: 144.0 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2016 PSIG
PGVP Number: A12020 Valve Outlet: 590
Gas Code: CH4,PPN,BALA Certification Date: Oct 16, 2020
Expiration Date: Oct 16, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
METHANE	4000 PPM	4019 PPM	G1	+/- 1.0% NIST Traceable	10/16/2020
PROPANE	4000 PPM	4008 PPM	G1	+/- 0.7% NIST Traceable	10/09/2020
AIR	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	02010405	K010090	4976 PPM PROPANE/NITROGEN	+/- 0.6%	Dec 02, 2021
NTRM	170608	CC160290	0.967 % METHANE/NITROGEN	+/- 0.4%	Aug 22, 2023

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CH4 - 000928781	FTIR	Oct 14, 2020
Nicolet 6700 APW1100391 C3H8	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES: NET WEIGHTS: 4.865kg
GROSS WEIGHTS: 27.365kg
PO#: 5220003825



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CALIBRATION LABORATORY CO., LTD.

210-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrasa, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.com E-mail: sale@cal-lab.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM13368/UM13368
CLID. NO. : 251900391
JOB CONTROL NO. : 230211015868

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

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 14 February 2023

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
Calibration Engineer

Approved By : Mongkol Yotsontorn
Authorized Signatory
14 February 2023



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. Q23015868
F3-011-04/01-12

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UMI13368/UMI13368
DATE OF CALIBRATION : 13 February 2023

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$ Relative Humidity : $(55 \pm 15) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-08 based on ISO 16063-21 as calibration guideline.
The calibration was performed by using Digital Multimeter, High Resolution Programmable Timer/Counter, Accelerometer and Measuring Amplifier which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

1. Digital Multimeter, Wavetek Model 1281 S/N. 29320.
2. High Resolution Programmable Timer/Counter, Philips Model PM6680B S/N. SM607101.
3. Accelerometer with Measuring Amplifier, Bruel & Kjaer Model 8305, 2525 S/N. 39701R, 2434988.

TRACEABILITY :

1. The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 05-0207/21, Due Date 31 May 2023.
2. The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 07-0001/22, Due Date 22 February 2023.
3. The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. AV-0009-22, Due Date 22 June 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M-2022)"

Certificate No. Q23015868

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CALIBRATION DATA

3. DISPLACEMENT RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm)	(frequency)		(mm)	(mm)	(mm)	\pm (% of rdg.)
*0.03	50 Hz	peak	0.030	0.030	0.000	2.1
*0.04	50 Hz		0.040	0.040	0.000	1.7
*0.05	50 Hz		0.050	0.050	0.000	1.5
*0.06	50 Hz		0.060	0.060	0.000	1.3
*0.07	50 Hz		0.070	0.071	-0.001	1.4
0.03	100 Hz	peak	0.030	0.030	0.000	2.1
0.04	100 Hz		0.040	0.040	0.000	1.7
0.05	100 Hz		0.050	0.050	0.000	1.5
0.06	100 Hz		0.060	0.061	-0.001	1.3
0.07	100 Hz		0.070	0.071	-0.001	1.2

Note. * means Calibrations marked * Not ANAB Accredited * in this Certificate have been included for completeness.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 1 of 58

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

End of Certificate

Certificate No. Q23015868

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CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

CALIBRATION DATA

1. ACCELERATION RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(g)	(frequency)		(g)	(g)	(g)	\pm (% of rdg.)
0.3	50 Hz	peak	0.300	0.302	-0.002	1.9
0.4	50 Hz		0.400	0.404	-0.004	1.9
0.5	50 Hz		0.500	0.506	-0.006	1.3
0.6	50 Hz		0.600	0.608	-0.008	1.3
0.7	50 Hz		0.700	0.710	-0.010	1.3
0.3	100 Hz	peak	0.300	0.303	-0.003	1.9
0.4	100 Hz		0.400	0.405	-0.005	1.9
0.5	100 Hz		0.500	0.507	-0.007	1.3
0.6	100 Hz		0.600	0.609	-0.009	1.3
0.7	100 Hz		0.700	0.710	-0.010	1.3

2. VELOCITY RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm/s)	(frequency)		(mm/s)	(mm/s)	(mm/s)	\pm (% of rdg.)
3	50 Hz	peak	3.000	3.022	-0.022	1.8
4	50 Hz		4.000	4.033	-0.033	1.8
5	50 Hz		5.000	5.043	-0.043	1.8
6	50 Hz		6.000	6.051	-0.051	1.8
7	50 Hz		7.000	7.067	-0.067	1.8
3	100 Hz	peak	3.000	3.023	-0.023	1.8
4	100 Hz		4.000	4.031	-0.031	1.8
5	100 Hz		5.000	5.043	-0.043	1.8
6	100 Hz		6.000	6.051	-0.051	1.8
7	100 Hz		7.000	7.063	-0.063	1.8

Certificate No. Q23015868

F3-011-04/01-12

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Certificate of Calibration

Customer

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

Certificate No : 23-ACT-111
Request No : Req-2023-1408

Unit Under Calibration Details

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

Class : 1
Range : 94 , 114 dB / 1000 Hz
Instrument Status : Used

Calibration Environment and Details

Temperature : $(23 \pm 2) ^\circ\text{C}$
Humidity : $(50 \pm 20) \% \text{RH}$
Barometric Pressure : $(1013 \pm 10.0) \text{ hPa}$
Received Date : 26 June 2023
Calibration Date : 27 June 2023
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 2024
THD Multimeter	2015	1047765	NIMT	31 January 2024

Traceability : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

Note

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

Calibrated By :

Mr. Noppadon Luangart
Service Calibration Engineer

Approved By :

Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 27 June 2023

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

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Certificate No : 23-ACT-111

Request No : Req-2023-1408

Calibration Results : Without Adjustment

Sound pressure level

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.84	-0.16	-	-	0.14	0.25
114 dB / 1000 Hz	113.79	-0.21	-	-	0.13	0.25

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (%)	Error (%)	Measured (%)	Error (%)		
94 dB / 1000 Hz	0.17	-	-	-	0.40	2.5
114 dB / 1000 Hz	0.04	-	-	-	0.40	2.5

Note :

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

End of Calibration

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

PM-001

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Calibration Certificate

Certificate Number 2023003661

Customer:

United Analyst and Engineering Consultant Co Ltd

No. 81 Soi Udomsak 41, Sukhumvit Road,

Bangchak, Phra Khanong,

Bangkok, 10260, Thailand

Model Number LxT1

Serial Number 0007304

Test Results Pass

Initial Condition As Manufactured

Description SoundTrack LxT Class 1

Class 1 Sound Level Meter

Firmware Revision: 2.404

Procedure Number D0001.8384

Technician Jacob Cannon

Calibration Date 23 Mar 2023

Calibration Due

Temperature 23.64 °C ± 0.25 °C

Humidity 50.1 %RH ± 2.0 %RH

Static Pressure 85.98 kPa ± 0.13 kPa

Evaluation Method

Tested with:

PCB 377B02, S/N 345233

Larson Davis CAL200, S/N 9079

Larson Davis PRMLX1, S/N 077639

Larson Davis CAL291, S/N 0108

Data reported in dB re 20 µPa.

Compliance Standards

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

IEC 60651:2001 Type 1

IEC 60804:2000 Type 1

IEC 61252:2002

IEC 61260:2001 Class 1

IEC 61672:2013 Class 1

ANSI S1.4-2014 Class 1

ANSI S1.4 (R2008) Type 1

ANSI S1.11 (R2009) Class 1

ANSI S1.25 (R2007)

ANSI S1.43 (R2007) Type 1

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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716-684-0001



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Certificate Number 2023003661

1/2" adaptor is used with the preamplifier.

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

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

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-034218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1; the sound level meter submitted for testing conforms to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Description	Standards Used		
	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL290 Acoustic Calibrator	2022-07-21	2023-07-21	007037
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Pre-polarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS560 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

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

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.52	-52.44	-48.33	0.14	Pass

— End of measurement results—

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.21	-0.20	-1.20	0.80	0.23	Pass
1000	0.18	0.00	-0.70	0.70	0.23	Pass
8000	-3.39	-3.00	-6.50	-1.50	0.32	Pass

— End of measurement results—

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Certificate Number 2023003661

Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	47.44

— End of measurement results—

— End of Report—

Signature:

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Calibration Certificate

Certificate Number 2023003633

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

Model Number LxT1
Serial Number 0007304
Test Results Pass
Initial Condition As Manufactured
Description SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378
Technician Jacob Cannon
Calibration Date 23 Mar 2023
Calibration Due
Temperature 23.57 °C ± 0.25 °C
Humidity 50.3 %RH ± 2.0 %RH
Static Pressure 86.12 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077639 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1
IEC 60804:2000 Type 1
IEC 61252:2002
IEC 61672:2013 Class 1
IEC 61260:2001 Class 1

ANSI S1.4-2014 Class 1
ANSI S1.4 (R2008) Type 1
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 1
ANSI S1.11 (R2009) Class 1

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

The quality system is registered to ISO 9001:2015.

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

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

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Ltd, 1770.01 Rev O Supporting Firmware Version 4.0.8, 2019 09 10

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

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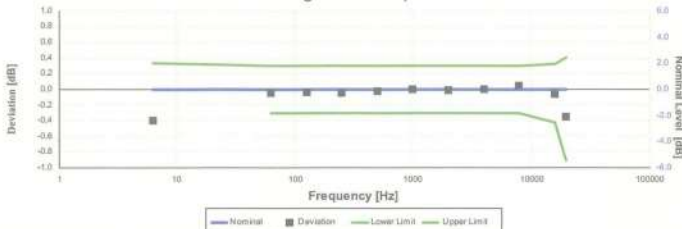


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Certificate Number 2023003633

Z-weight Filter Response



Electrical signal list of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5, IEC 60651:2001 6.1 and 9.2.2, IEC 60804:2000 5, ANSI S1.4-1983 (R2006) 5.1 and 8.2.1, ANSI S1.4-2014 Part 1: 8.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.40	-0.40	-1.11	0.33	0.15	Pass
63.10	-0.05	-0.05	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,003.90	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.01	-0.01	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.04	0.04	-0.30	0.30	0.15	Pass
15,848.93	-0.06	-0.06	-0.42	0.32	0.15	Pass
19,952.62	-0.35	-0.35	-0.91	0.41	0.15	Pass

-- End of measurement results--

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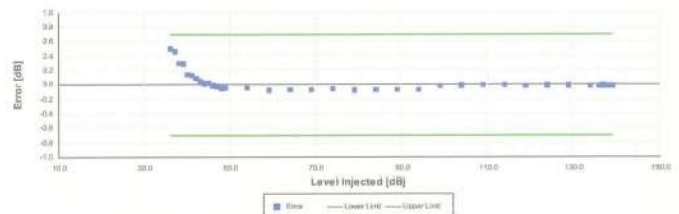


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Certificate Number 2023003633

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.8, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.50	-0.70	0.70	0.16	Pass
37.00	0.46	-0.70	0.70	0.16	Pass
38.00	0.30	-0.70	0.70	0.16	Pass
39.00	0.29	-0.70	0.70	0.16	Pass
40.00	0.15	-0.70	0.70	0.16	Pass
41.00	0.13	-0.70	0.70	0.16	Pass
42.00	0.09	-0.70	0.70	0.16	Pass
43.00	0.04	-0.70	0.70	0.17	Pass
44.00	0.02	-0.70	0.70	0.17	Pass
45.00	0.02	-0.70	0.70	0.16	Pass
46.00	-0.01	-0.70	0.70	0.16	Pass
47.00	-0.02	-0.70	0.70	0.16	Pass
48.00	-0.05	-0.70	0.70	0.16	Pass
49.00	-0.04	-0.70	0.70	0.16	Pass
50.00	-0.04	-0.70	0.70	0.16	Pass
59.00	-0.07	-0.70	0.70	0.16	Pass
64.00	-0.07	-0.70	0.70	0.16	Pass
69.00	-0.07	-0.70	0.70	0.16	Pass
74.00	-0.06	-0.70	0.70	0.16	Pass
79.00	-0.07	-0.70	0.70	0.16	Pass
84.00	-0.07	-0.70	0.70	0.16	Pass
89.00	-0.07	-0.70	0.70	0.16	Pass
94.00	-0.07	-0.70	0.70	0.16	Pass
99.00	-0.01	-0.70	0.70	0.15	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	0.00	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	-0.01	-0.70	0.70	0.15	Pass
124.00	-0.01	-0.70	0.70	0.15	Pass
129.00	-0.01	-0.70	0.70	0.15	Pass
134.00	-0.01	-0.70	0.70	0.15	Pass
136.00	-0.01	-0.70	0.70	0.15	Pass
137.00	-0.01	-0.70	0.70	0.15	Pass
138.00	-0.01	-0.70	0.70	0.15	Pass
139.00	-0.02	-0.70	0.70	0.15	Pass

-- End of measurement results--

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Peak Rise Time

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

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.19	133.74	135.74	0.15	Pass
		Positive Pulse	135.20	133.73	135.73	0.15	Pass
		Negative Pulse	134.28	133.74	135.74	0.15	Pass
	30	Negative Pulse	134.25	133.73	135.73	0.15	Pass
		Positive Pulse					
		Positive Pulse					

-- End of measurement results --

Positive Pulse Crest Factor

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

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.12	± 0.50	0.15 ±	Pass
	5	-0.11	± 1.00	0.16 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.26	± 1.50	0.15 ±	Pass
106.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.16	± 1.50	0.15 ±	Pass

-- End of measurement results --

Negative Pulse Crest Factor

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

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.11	± 0.50	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.25	± 1.50	0.15 ±	Pass
106.85	3	-0.12	± 0.50	0.15 ±	Pass
	5	-0.11	± 1.00	0.15 ±	Pass
	10	-0.16	± 1.50	0.15 ±	Pass

-- End of measurement results --



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Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.95	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.09	40.30	41.70	0.16	Pass
CBA Low Range	94.00	93.90	94.10	0.15	Pass
CBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results --

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	29.43	36.00	Pass
C-weight Noise Floor	28.93	35.00	Pass
Z-weight Noise Floor	33.44	39.00	Pass

-- End of measurement results --

Total Harmonic Distortion

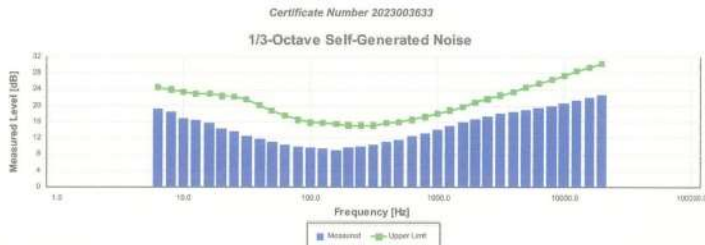
Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.76	135.05	136.65	0.15	Pass
THD	-66.65	-58.00	-58.00	0.01 ±	Pass
THD+N	-62.62	-58.00	-58.00	0.01 ±	Pass

-- End of measurement results --



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The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	19.29	24.60	Pass
8.00	18.45	24.00	Pass
10.00	16.85	23.50	Pass
12.50	16.37	23.00	Pass
16.00	15.82	22.90	Pass
20.00	14.52	22.40	Pass
25.00	13.64	22.30	Pass
31.50	12.57	21.50	Pass
40.00	11.80	20.20	Pass
50.00	11.13	18.80	Pass
63.00	10.46	17.60	Pass
80.00	10.08	16.60	Pass
100.00	9.85	15.90	Pass
125.00	9.47	15.70	Pass
160.00	9.11	15.50	Pass
200.00	9.57	15.20	Pass
250.00	10.03	15.20	Pass
315.00	10.45	15.20	Pass
400.00	11.08	15.70	Pass
500.00	11.68	16.00	Pass
630.00	12.49	16.60	Pass
800.00	13.31	17.30	Pass
1,000.00	14.19	18.10	Pass
1,250.00	15.03	18.90	Pass
1,600.00	15.92	19.80	Pass
2,000.00	16.69	20.80	Pass
2,500.00	17.42	21.70	Pass
3,150.00	18.00	22.60	Pass
4,000.00	18.51	23.50	Pass
5,000.00	18.96	24.50	Pass
6,300.00	19.51	25.50	Pass
8,000.00	20.05	26.50	Pass
10,000.00	20.57	27.40	Pass
12,500.00	21.26	28.50	Pass
16,000.00	21.97	29.50	Pass
20,000.00	22.79	30.40	Pass

-- End of measurement results --



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-- End of Report --

Signature



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Calibration Certificate

Certificate Number 2023003660

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

Model Number	LxT1	Procedure Number	D0001.8384
Serial Number	0007303	Technician	Jacob Cannon
Test Results	Pass	Calibration Date	23 Mar 2023
Initial Condition	As Manufactured	Calibration Due	
Description	SoundTrack LxT Class 1	Temperature	23.68 °C ± 0.25 °C
	Class 1 Sound Level Meter	Humidity	49.4 %RH ± 2.0 %RH
	Firmware Revision: 2.404	Static Pressure	86 kPa ± 0.13 kPa

Evaluation Method Tested with: Data reported in dB re 20 µPa.

Larson Davis PRMLxT1, S/N 077638
PCB 377B02, S/N 345232
Larson Davis CAL291, S/N 0108
Larson Davis CAL200, S/N 9079

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

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2008) Type 1
IEC 61252:2002	ANSI S1.11 (R2009) Class 1
IEC 61260:2001 Class 1	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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Certificate Number 2023003660

1/2" adaptor is used with the preamplifier.

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

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

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-0334218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013 / ANSI/ASA S1.4-2014/Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1; the sound level meter submitted for testing conforms to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Description	Standards Used		
	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2023-07-21	2023-07-21	007027
Larson Davis Model 931	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 931 Type 1	2023-09-28	2023-09-28	PCB0094783

Acoustic Calibration

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

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.56	-52.44	-48.33	0.14	Pass

– End of measurement results–

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.23	-0.20	-1.20	0.80	0.23	Pass
1000	0.17	0.00	-0.70	0.70	0.23	Pass
8000	-3.19	-3.00	-5.50	-1.50	0.32	Pass

– End of measurement results–

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Certificate Number 2023003660

Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	42.55

– End of measurement results–

– End of Report–

Signature: _____

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Calibration Certificate

Certificate Number 2023003636

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

Model Number	LxT1	Procedure Number	D0001.8378
Serial Number	0007303	Technician	Jacob Cannon
Test Results	Pass	Calibration Date	23 Mar 2023
Initial Condition	As Manufactured	Calibration Due	
Description	SoundTrack LxT Class 1	Temperature	23.66 °C ± 0.25 °C
	Class 1 Sound Level Meter	Humidity	50.2 %RH ± 2.0 %RH
	Firmware Revision: 2.404	Static Pressure	86.12 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077638 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2008) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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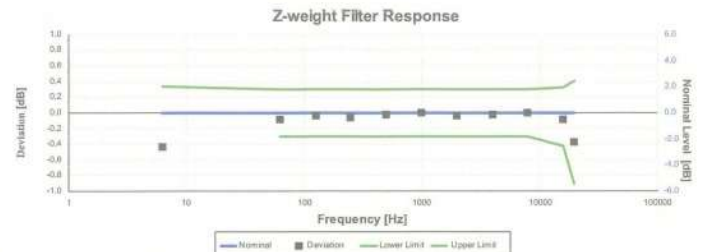
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Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-12-29	2023-12-29	007118



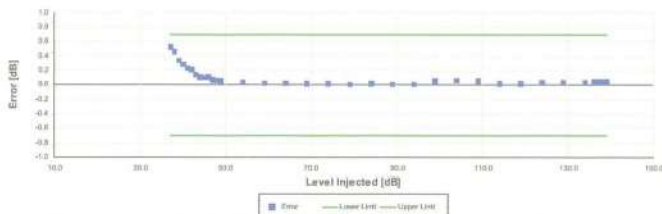
Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5, IEC 60651:2001 6.1 and 9.2.2, IEC 60804:2000 9, ANSI S1.4-1983 (R2006) 5.1 and 5.2.1, ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.43	-0.43	-1.11	0.33	0.15	Pass
63.10	-0.08	-0.08	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.06	-0.06	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-0.03	-0.30	0.30	0.15	Pass
3,981.07	-0.02	-0.02	-0.30	0.30	0.15	Pass
7,943.28	0.00	0.00	-0.30	0.30	0.15	Pass
15,848.93	-0.08	-0.08	-0.42	0.32	0.15	Pass
19,952.62	-0.37	-0.37	-0.91	0.41	0.15	Pass

— End of measurement results—

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A-weighted Broadband Log Linearity: 8,000.00 Hz

Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.8, IEC 60804:2000 8.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 8.2, ANSI S1.4-2014 Part 1: 5.8, ANSI S1.4.3 (R2007) 8.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
37.00	0.53	-0.70	0.70	0.16	Pass
38.00	0.46	-0.70	0.70	0.16	Pass
39.00	0.33	-0.70	0.70	0.16	Pass
40.00	0.29	-0.70	0.70	0.16	Pass
41.00	0.23	-0.70	0.70	0.16	Pass
42.00	0.22	-0.70	0.70	0.16	Pass
43.00	0.15	-0.70	0.70	0.17	Pass
44.00	0.11	-0.70	0.70	0.17	Pass
45.00	0.10	-0.70	0.70	0.16	Pass
46.00	0.11	-0.70	0.70	0.16	Pass
47.00	0.07	-0.70	0.70	0.16	Pass
48.00	0.06	-0.70	0.70	0.16	Pass
49.00	0.06	-0.70	0.70	0.16	Pass
54.00	0.04	-0.70	0.70	0.16	Pass
59.00	0.02	-0.70	0.70	0.16	Pass
64.00	0.02	-0.70	0.70	0.16	Pass
69.00	0.02	-0.70	0.70	0.16	Pass
74.00	0.02	-0.70	0.70	0.16	Pass
79.00	0.01	-0.70	0.70	0.16	Pass
84.00	0.02	-0.70	0.70	0.16	Pass
89.00	0.01	-0.70	0.70	0.16	Pass
94.00	0.01	-0.70	0.70	0.16	Pass
99.00	0.06	-0.70	0.70	0.15	Pass
104.00	0.06	-0.70	0.70	0.15	Pass
109.00	0.06	-0.70	0.70	0.15	Pass
114.00	0.02	-0.70	0.70	0.15	Pass
119.00	0.02	-0.70	0.70	0.15	Pass
124.00	0.04	-0.70	0.70	0.15	Pass
129.00	0.04	-0.70	0.70	0.15	Pass
134.00	0.04	-0.70	0.70	0.15	Pass
136.00	0.04	-0.70	0.70	0.15	Pass
137.00	0.04	-0.70	0.70	0.15	Pass
138.00	0.05	-0.70	0.70	0.15	Pass
139.00	0.04	-0.70	0.70	0.15	Pass

— End of measurement results—

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Peak Rise Time

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

Amplitude [dB]	Duration [μs]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.21	133.74	0.15	Pass
		Positive Pulse	135.21	133.73	0.15	Pass
134.28	30	Negative Pulse	134.28	133.74	0.15	Pass
		Positive Pulse	134.23	133.73	0.15	Pass

— End of measurement results—

Positive Pulse Crest Factor

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVL	± 0.50	0.15 ±	Pass
	5	OVL	± 1.00	0.15 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
126.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.16 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
116.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
	10	-0.05	± 1.50	0.15 ±	Pass
106.85	3	-0.15	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.17	± 1.50	0.15 ±	Pass

— End of measurement results—

Negative Pulse Crest Factor

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

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVL	± 0.50	0.15 ±	Pass
	5	OVL	± 1.00	0.15 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
126.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	OVL	± 1.50	0.15 ±	Pass
116.85	3	-0.14	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
	10	0.00	± 1.50	0.15 ±	Pass
106.85	3	-0.15	± 0.50	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
	10	-0.17	± 1.50	0.15 ±	Pass

— End of measurement results—

เอกสารไม่ควบคุม

Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.95	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.13	40.30	41.70	0.16	Pass
OBA Low Range	94.00	93.90	94.10	0.15	Pass
OBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results --

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	27.01	36.00	Pass
C-weight Noise Floor	26.70	35.00	Pass
Z-weight Noise Floor	32.64	39.00	Pass

-- End of measurement results --

Total Harmonic Distortion

Measured using 1/3-Octave filters

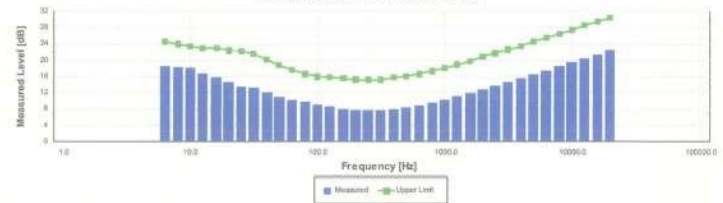
Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.76	135.05	136.65	0.15	Pass
THD	-67.22		-68.00	0.01 ‡	Pass
THD+N	-62.91		-68.00	0.01 ‡	Pass

-- End of measurement results --



เอกสารไม่ควบคุม

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	18.55	24.50	Pass
8.00	18.33	24.00	Pass
10.00	18.11	23.50	Pass
12.50	16.77	23.00	Pass
16.00	15.74	22.90	Pass
20.00	14.70	22.40	Pass
25.00	13.54	22.30	Pass
31.50	13.13	21.50	Pass
40.00	12.18	20.20	Pass
50.00	10.89	18.80	Pass
63.00	10.30	17.60	Pass
80.00	9.65	16.60	Pass
100.00	9.08	15.90	Pass
125.00	8.51	15.70	Pass
160.00	7.86	15.50	Pass
200.00	7.66	15.20	Pass
250.00	7.66	15.20	Pass
315.00	7.68	15.20	Pass
400.00	7.98	15.70	Pass
500.00	8.38	16.00	Pass
630.00	8.87	16.60	Pass
800.00	9.56	17.30	Pass
1,000.00	10.29	18.10	Pass
1,250.00	11.10	18.90	Pass
1,600.00	11.90	19.80	Pass
2,000.00	12.78	20.80	Pass
2,500.00	13.70	21.70	Pass
3,150.00	14.55	22.60	Pass
4,000.00	15.46	23.50	Pass
5,000.00	16.50	24.50	Pass
6,300.00	17.50	25.50	Pass
8,000.00	18.46	26.50	Pass
10,000.00	19.44	27.40	Pass
12,500.00	20.45	28.50	Pass
16,000.00	21.46	29.50	Pass
20,000.00	22.43	30.40	Pass

-- End of measurement results --



เอกสารไม่ควบคุม

-- End of Report --

Signatory: Jacob Cannon

เอกสารไม่ควบคุม

List of Instrument/Equipment Certification for Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model / Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Laboratory Instrument/Equipments Water Quality Analysis.									
1	pH Meter	pH Temperature	Mettler-Toledo	SevenEasy pH/ 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-1	24 Mar 23	22 Mar 24	-
2	Analytical Balance (Readability 0.01 mg)	Suspended Solids Total Dissolved Solids	Mettler-Toledo	AB204-S/ 1128312528	Technology Promotion Association (Thailand-Japan)	23MM331	7 Apr 23	5 Apr 24	-
3	Hot Air Oven		Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	2400141-001-01	11 Oct 23	9 Oct 24	-
4	Incubator	Total Coliform Bacteria Fecal Coliform Bacteria	Binder	BD 53 E2/ 13-07343	Technology Promotion Association (Thailand-Japan)	23TM192	15 Feb 23	14 Feb 24	-
5	Incubator		Memmert	IF 75 / D317.0305	Technology Promotion Association (Thailand-Japan)	23TM727	28 Apr 23	26 Apr 24	-
6	Water Bath		Memmert	IN 75 / D317.0307	Technology Promotion Association (Thailand-Japan)	23TM765	27 Apr 23	25 Apr 24	-
7	Water Bath		Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	23TM728	28 Apr 23	26 Apr 24	-
8	Analytical Balance		Ohaus	PX623 / C236754745	DKSH Technology Limited	C01223732	9 Dec 22	8 Dec 23	-
9	Auto Clave		ALP	CL-40L / 808	Technology Promotion Association (Thailand-Japan)	23TM763	27 Apr 23	25 Apr 24	-
10	Analytical Balance	Fat Oil & Grease	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-

List of Instrument/Equipment Certification for Quality Analysis.

No.	Instrument/Equipment	Parameter	Manufacturer	Model / Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Laboratory Instrument/Equipments Water Quality Analysis.									
11	BOD Incubator	BOD	Arco	UC4-1320/ 13URC45013201	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
12	Digestor Unit	TKN	FOSS TECATOR	2520/ 91794469	National Food Institute, Ministry of Industry, Thailand	2302413-001	28 Mar 23	26 Mar 24	-
13	Distillation Unit (Kjeldahl Method)		FOSS TECATOR	KT8100 / 91889052	FOSS South East Asia	8411	29 May 23	27 May 24	-

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

Calibration Certificate

Certificate No.: 2302181-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhnong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Order No.: 2302181
Operation No.: 2302181-001
Date of Receipt: 14 March 2023
Date of Calibration: 24 March 2023

Calibrated by Mr.Pheraphat Tuanjit **Approved by** [Signature]
Scientist (Mr.Nuttapol Niyomchart)
Specialist, Division of Calibration Laboratory
Date of Issue: 24 March 2023 **Responsible for the Technical Management Team**

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.

F-CS-009 Revision: 01 Date: 20-04-65



เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2302181-001-01
Equipment: pH Meter
Resolution: 0.01 pH : 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Type: Bench top

Date of Calibration: 24 March 2023 **Page 2 of 5**

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (23.4 ± 1.5) °C **Relative Humidity:** (52 ± 3) %
Condition of Equipment: Good Condition

Condition of this Results of Calibration

1. Calibration Method In house method : W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fuke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fuke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI8TH003/17	PONPE	TE 650555-01	21 September 2023
Certified Reference Material				
	Lot No.	Manufacturer	Ref N	Expires Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH216.L5	18 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH217.L5	18 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH220.L5	18 February 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107.L5	16 February 2024

3. This certification is traceable to The International System of Unit (SI Unit)
3.1 Instruments No.2.1 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No.2.2 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3 through NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.4 Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method- Hamed cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No.2.7 traceable to BIM Refn Hi-13 Lot# 25.05.2022; BIM Refn Hi-16 Lot# 02.06.2022; BIM Refn Hi-13 Lot# 25.05.2022; BIM Refn Hi-16 Lot# 02.06.2022, the Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

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

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

F-CS-012 Revision: 01 Date: 20-04-65



เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2302181-001-01
Equipment: pH Meter
Resolution: 0.01 pH : 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Type: Bench top

Date of Calibration: 24 March 2023 **Page 3 of 5**

Calibration Results:
1. Calibration of pH Meter (Manual Temperature Compensation at 25 °C)

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.126	414	0.00	0.58	2.00
2	295.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.000	0	7.00	0.58	2.00
8	-59.158	-59	8.00	0.58	2.00
10	-177.460	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.117	-414	14.00	0.58	2.00

2. Calibration of pH Meter with Electrode (Manual Temperature Compensation at 25 °C)

Equipment: pH Electrode **Type:** Combined Electrode
Manufacturer: METTLER TOLEDO **Model:** InLab Solids
Serial No.: 1156883 **ID No.:** N/A

Performance of Electrode system (Three-Point Calibration at pH 4, pH 7 and pH 10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	187	-	0.0071	2.00
6.865	6.86	22	97.86	0.0075	2.00
10.010	10.01	-160	97.86	0.0086	2.00
6.985	6.99	14	-	0.0093	2.00

F-CS-012 Revision: 01 Date: 20-04-65



เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2302181-001-01
Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C
Model: SevenEasy pH
Serial No.: 1230525212
ID No.: UAE.WAS.003/2553
Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023 **Page 4 of 5**

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature 25 °C ± 1 °C
Relative Humidity 55 % ± 5 %

Condition of this results of Calibration:

- Calibration Method : - In house method: W-TE-025 by comparison with standard thermometer.
- The Calibration is determined by comparing with a known temperature from a standard resistance thermometer.
- The temperature scale in use at this laboratory is the International Temperature scale of 1990 (ITS-90).

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1521	A85997	TE 660039-01	10-Dec-23	NATIONAL FOOD INSTITUTE
Platinum Resistance Thermometer (PRT)	385	509201			

Support Equipment : - Low Temperature Bath (ISOCAL-6), Model: Europa-6 Plus Basic, S/N: 341592/2

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good
- Result of Calibration : ☒ Without adjustment ☐ After adjustment

F-CS-012 Revision: 01 Date: 20-04-65



เอกสารไม่ควบคุม

Calibration Certificate

Certificate No.: 2400141-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: CHAMBER (Hot Air Oven)
Manufacturer: MEMMERT
Model: UF 55
Serial No.: B216.1666
ID No.: UAE.WAO.027/2559
Order No.: 2400141
Operation No.: 2400141-001
Date of Receipt: 11 October 2023
Date of Calibration: 11 October 2023

Calibrated by Mr.Worapob Sooktong
Scientist
Approved by (Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team
Date of Issue: 16 October 2023

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.

F-C5-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2400141-001-01
Equipment: CHAMBER (Hot Air Oven)
Model: UF 55
Serial No.: B216.1666
Resolution: 0.1 °C
ID No.: UAE.WAO.027/2559
Manufacturer: MEMMERT
Date of Calibration: 11 October 2023

Page 3 of 3

Calibration point: 104.0, 140.0 and 180.0 °C

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
MIN	28.2	61.4	227.4
MAX	28.3	65.1	229.3

Table 1 : Reporting of Temperature

Calibration point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9	
104.0	104.05	103.98	104.02	104.08	104.00	104.05	103.99	104.17	104.00	0.53
140.0	140.09	139.99	139.91	140.05	139.99	139.91	139.97	140.26	139.97	0.73
180.0	180.46	180.33	180.25	180.28	180.33	179.96	180.31	180.64	180.16	0.90

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	MIN	MAX	Average			
104.0	104.0	104.0	104.0	0.090	0.18	0.38
140.0	140.0	140.1	140.0	0.075	0.28	0.47
180.0	180.0	180.1	180.0	0.13	0.48	0.88

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

***** End *****

F-C5-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2400141-001-01
Equipment: CHAMBER (Hot Air Oven)
Model: UF 55
Serial No.: B216.1666
Resolution: 0.1 °C
ID No.: UAE.WAO.027/2559
Manufacturer: MEMMERT
Date of Calibration: 11 October 2023

Page 2 of 3

Location: Laboratory, Floor 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Environment Condition: Ambient Temperature (28 ± 1) °C
Relative Humidity (63 ± 2) %
Line Voltage (228 ± 1) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 9 standard thermometer into its chamber and calibration according to W-TE-014 Based on TLAS G-20-1/02-08 (E): Guidelines for Calibration and Checks of Temperature Controlled Enclosures.
- The temperature scale used was based on ITS - 90.
- All data show below were final values and the initial data may be obtained upon request.
- Reference Standard Instrument :

Instrument	Model	Serial No./ID No.	Certificate No.	Due Date	Through
Digital Thermometer with sensor	34972A	MY49016894	TE 660380-01	22 April 2024	NATIONAL FOOD INSTITUTE
	RTD	CH#201-208/ RTD#201-208			

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC Description :
Time of Record 1 Hour 9 Minute At 104.0, 140.0 and 180.0 °C
Fresh air Damper - Open Position -
X Close
- Not Available
7. Result of Calibration : X Without adjustment After adjustment

F-C5-012 Revision: 01 Date: 20-04-65



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



IAC-MRA
NSC-TIS-1718 17025
CALIBRATION 0081

Cert. No.: 23TM192
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Binder
Model : BD 53 E2
Serial No. : 13-07343
ID No. : UAE.MIC.005/2558
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Prakhonong,
Bangkok 10260
Location : Microbiology Laboratory
Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Suwit Imjai
Approved by : () Pornthippa Tameyakul
() Malee Bulkruea
Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : Incubator
Condition As-Received : Used Item
Reference : 2302-0295OC-1
Procedure Used :-

Cert. No.: 23TM192
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

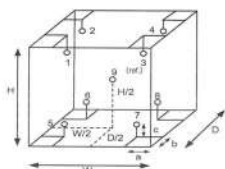
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
D = 0.33 m
W = 0.40 m
H = 0.40 m
Capacity = 0.053 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	22	23
REL.Humid. (%)	65	61
AC Supply (Volt)	231	231

Position :	Ref. Std. ID No.:
1	20RTD-2/1
2	20RTD-2/2
3	20RTD-2/3
4	20RTD-2/4
5	20RTD-2/5
6	20RTD-2/6
7	20RTD-2/7
8	20RTD-2/8
9 (ref.)	20RTD-2/9

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2302-0295OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM192
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
35.0	35.4	35.4	0.037	0.66	0.66	0.30	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
35.0	1	2	3	4	5	6	7	8	9 (ref.)
	35.256	35.308	35.116	35.453	34.700	34.798	34.718	34.657	34.938

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & 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.: 23TM727
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Memmert
Model : IF 75
Serial No. : D317.0305
ID No. : UAE.MIC.022/2561
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (302)
Received Order : 27 April 2023
Calibration Date : 27 - 28 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Tawatchai Pama
Approved by :
() Pornthippa Tameyakul
(/) Malee Butkruea
() Suwit Imjai
Issue Date : 11 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 & Equipment Calibration and Testing Services.

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM727
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
44.0	44.0	44.0	0.055	0.42	0.52	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
44.0	43.993	44.061	44.107	44.073	44.067	44.067	43.938	43.687	44.060	0.30

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-4
Procedure Used :-

Cert. No.: 23TM727
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

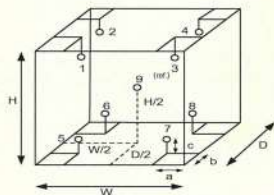
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	24
REL.Humid. (%)	76	80
AC Supply (Volt)	231	231



Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
D = 0.33 m
W = 0.40 m
H = 0.56 m
Capacity = 0.074 m³

เอกสารไม่ครบ



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & 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.: 23TM765
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator

Manufacturer : Memmert

Model : IN 75

Serial No. : D317.0307

ID No. : UAE.MIC.023/2561

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

Location : Microbiology Laboratory (302)

Received Order : 27 April 2023

Calibration Date : 27 April 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hiahib

Approved by :

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

Approved Signatory

Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

เอกสารไม่ครบ



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-5
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM765
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
37.0	37.0	37.0	0.070	0.28	0.39	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
37.0	37.164	37.118	37.079	37.121	36.852	37.039	36.822	36.923	36.905	0.30

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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-

เอกสารไม่ครบ



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-5

Cert. No.: 23TM765
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

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

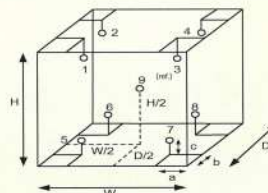
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	22
REL.Humid. (%)	69	73
AC Supply (Volt)	220	221



Position :	Ref. Std. ID No.:
1	20RTD-2/1
2	20RTD-2/2
3	20RTD-2/3
4	20RTD-2/4
5	20RTD-2/5
6	20RTD-2/6
7	20RTD-2/7
8	20RTD-2/8
9 (ref.)	20RTD-2/9

Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
D = 0.32 m
W = 0.42 m
H = 0.56 m
Capacity = 0.075 m³

เอกสารไม่ครบ



Cert. No.: 23TM728
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Memmert
Model : IPP 260
Serial No. : V616.0066
ID No. : UAE.MIC.032/2559
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (302)
Received Order : 27 April 2023
Calibration Date : 27 - 28 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Tawatchai Pama

Approved by :

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

Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-6
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM728
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
25.0	25.0	25.0	0.020	0.81	1.2	2
36.0	36.0	36.0	0.15	1.1	1.6	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
25.0	25.541	25.354	25.388	25.278	24.341	24.349	24.379	24.455	24.747	0.30
36.0	35.275	35.351	35.768	35.941	36.543	36.590	36.653	36.728	36.232	0.39

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2304-0461OC-6

Cert. No.: 23TM728
Page : 2 of 3

Procedure Used :- Calibration were conducted using calibration procedure CP-OTD2 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

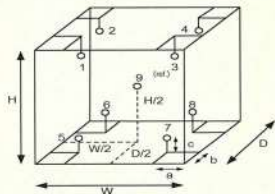
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	22
REL.Humid. (%)	76	83
AC Supply (Volt)	231	231



Probe Installation Details :

Dimension of Chamber :

a = 10 cm	D = 0.50 m
b = 10 cm	W = 0.64 m
c = 10 cm	H = 0.80 m
	Capacity = 0.26 m ³

Position :	Ref. Std. ID No.:
1	22-18RTD-2/1
2	18RTD-2/2
3	18RTD-2/3
4	18RTD-2/4
5	18RTD-2/5
6	18RTD-2/6
7	18RTD-2/7
8	18RTD-2/8
9 (ref.)	18RTD-2/9



Certificate of Calibration

Equipment: Balance
Model: PX623
Serial No. (or ID.): C236754745
Manufacturer: Ohaus
Condition: New

Certificate No.: C01223732
Issued Date: 09 December 2022
Job No.: KSPR2215576
Page: 1 of 2

Customer: United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Environment Condition: Temperature 26 °C ± 0.5 °C
Humidity 53 %RH ± 3.9 %RH

Calibration Place: United Analyst and Engineering Consultant Co., Ltd. (301 Microbiology Room)
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Calibration By: Mr. Adisai Maknoi
Calibration Date: 09 December 2022

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02221765

(Mr. Adisai Maknoi)

Person in charge

(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดักซ์ เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7050 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2022

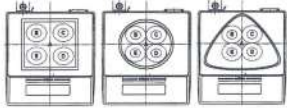
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เอกสารไม่ควบคุม

Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.



Nominal Test Value		200			(g)
Reference Points (g)					
A	B	C	D	E	
-	0.000	0.000	0.000	0.000	

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
50	0.0004
500	0.0005

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0010	2.03
5	5.0001	5.000	0.000	0.0010	2.03
10	10.0001	10.000	0.000	0.0010	2.03
20	20.0001	20.000	0.000	0.0010	2.03
50	50.0001	50.000	0.000	0.0010	2.03
100	100.0001	100.000	0.000	0.0011	2.03
200	200.0004	200.000	0.000	0.0011	2.02
300	300.0005	300.000	-0.001	0.0013	2.01
400	400.0008	400.001	0.000	0.0014	2.01
500	500.0003	500.000	0.000	0.0017	2.00
600	600.0004	600.000	0.000	0.0019	2.00

The End of Certificate

Statements of conformity:

This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, UKAS Lab14. Therefore, those parameters have not been assessed separately.

Tolerance and Decision rules:

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

- Decision rule :
- ☐ Choice A Binary Statement for Simple Acceptance Rule ($w = 0$), Specific Risk < 50% PFA.
 - ☒ Choice B Non-binary statement with guard band ($w = 1 U$), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.
 - ☐ Choice C Customer defined, Customers may define arbitrary multiple of r to have applied as guard band ($w = r U$).
- ; PFA – Probability of False Accept

(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

Statements of conformity:

Without Adjustment

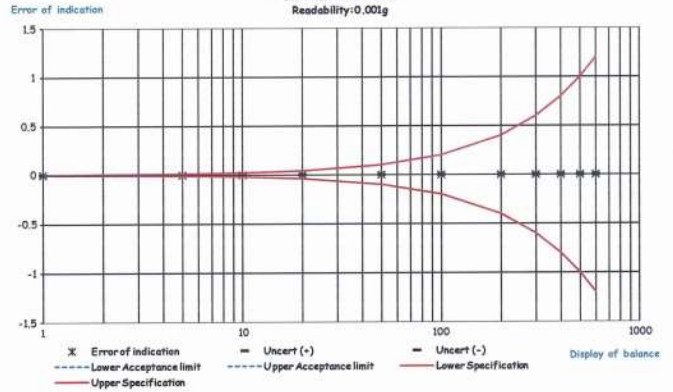
Readability: 0.001 g

Nominal Value (g)	Error of Indication (g)	Guard band (w) (g)	Tolerance (±) (g)	Conformity
1	0.000	0.0010	0.002	Pass
5	0.000	0.0010	0.010	Pass
10	0.000	0.0010	0.020	Pass
20	0.000	0.0010	0.040	Pass
50	0.000	0.0010	0.100	Pass
100	0.000	0.0011	0.200	Pass
200	0.000	0.0011	0.400	Pass
300	-0.001	0.0013	0.600	Pass
400	0.000	0.0014	0.800	Pass
500	0.000	0.0017	1.000	Pass
600	0.000	0.0019	1.200	Pass

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

The End of Statements of conformity

Without Adjustment
Job No. KSPR2215576
Readability: 0.001g





Cert. No.: 23TM763
Page : 1 of 3

Certificate of Calibration

Equipment : Autoclave
Manufacturer : ALP
Model : CL-40L
Serial No. : 808763
ID No. : UAE.MIC.026/2563
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (301)
Received Order : 27 April 2023
Calibration Date : 27 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hlahib
Approved by :
() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai
Issue Date : 11 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0053944



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2304-0461OC-2
Procedure Used :-

Cert. No.: 23TM763
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

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

3. This certification is traceable to the International System of Unit.

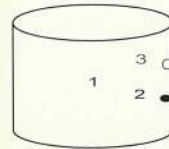
4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3**

(** = Categorization of pathogens according to hazard and categories of containment, second edition, 1990)
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source



	Environmental		
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	27	60	220
Finished of Calibration	27	58	220

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	18-20TC-04
2 =	Temperature sensor	18-20TC-05
3 =	Exhaust port	18-20TC-06

เอกสารไม่ควบคุม

a 1159968



Equipment : Autoclave
Condition As-Received : Used Item
Reference : 2304-0461OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 23TM763
Page : 3 of 3

Operating parameter Set : Temperature = 115.0 °C
Sterilization period = 15 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
115.0	115.0	1	115.213	0.22	0.08	0.75	2
		2	115.166				
		3	115.260				

Operating parameter Set : Temperature = 121.0 °C
Sterilization period = 30 minute

UUC* Setting (°C)	UUC* Reading (°C)	Position	Average* Standard Reading (°C)	Stability (± °C)	Pressure Reading (MPa)	Uncertainty (± °C)	Coverage Factor k
121.0	121.0	1	121.260	0.29	1.1	0.75	2
		2	121.224				
		3	121.284				

Average* : The average of 30 values in each position.

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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เอกสารไม่ควบคุม

a 1159967



Cert. No.: 23TM249
Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arco
Model : UC4-1320
Serial No. : 13URC4S013201
ID No. : UAE.WAO.015/2561
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hlahib
Approved by :
() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai
Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0051476


 PASS
 NOT PASS

Remarks

HPE: 20 ± 1°C
 (Signature)
 Verify Approve

Cert. No.: 23TM249

BOD Incubator

Arco

Model: UCA-1320

S/N: -

ID. No.: UAC.WAO.015(256)

17 Mar 2023 May 10, 2023
 02/17
 3 Apr. 167



Equipment : BOD Incubator
 Condition As-Received : Used Item
 Reference : 2302-0297OC-1
 Procedure Used :-

Cert. No.: 23TM249
 Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
 The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

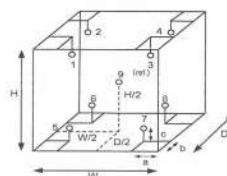
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



Probe Installation Details :

a = 10 cm
 b = 10 cm
 c = 10 cm

Dimension of Chamber :

D = 0.62 m
 W = 1.2 m
 H = 1.2 m
 Capacity = 0.89 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	29	31
REL.Humid. (%)	63	67
AC Supply (Volt)	220	220

Position :	Ref. Std. ID No.:
1	22-18RTD-2/1
2	18RTD-2/2
3	18RTD-2/3
4	18RTD-2/4
5	18RTD-2/5
6	18RTD-2/6
7	18RTD-2/7
8	18RTD-2/8
9 (ref.)	18RTD-2/9



Equipment : BOD Incubator
 Condition As-Received : Used Item
 Reference : 2302-0297OC-1
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Not Available

Cert. No.: 23TM249
 Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
20.0	20.0	19.3	0.32	0.57	1.0	0.60	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.838	19.837	19.821	19.949

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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 %.

-000-

Verification Certificate

Certificate No.: 2302413-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhong, Bangkok 10260

Page 1 of 4

Equipment: HEATING BLOCK DIGESTION
Manufacturer: FOSS
Model: 2520
Serial No.: 91794469
ID No.: UAE.WAS.011/2560
Order No.: 2302413
Operation No.: 2302413-001
Date of Receipt: 28 March 2023
Date of Calibration: 30-31 March 2023

Calibrated by Mr.Nuttapol Niyomchat **Approved by** (Mr.Pheraphat Tuanjit)
Specialist Manager, Division of Calibration Laboratory
Date of Issue: 10 April 2023 Responsible for the Technical Management Team

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: 01 Date: 20-04-65

2008 ถนนสุขุมวิท 35 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10710 เอกสารไม่ควบคุม
2008 Soi 35, Asin Anant Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10710, Thailand
Tel: +66(0) 2422 8568 Fax: +66(0) 2422 8545 nfi.com

Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
Model: 2520 Serial No.: 91794469
Resolution: 1 °C ID No.: UAE.WAS.011/2560
Manufacturer: FOSS
Date of Calibration: 30-31 March 2023 Page 2 of 4

Location: Laboratory Room, NATIONAL FOOD INSTITUTE
Environment Condition: Ambient Temperature (25 ± 3) °C
Relative Humidity (55 ± 15) %
Line Voltage (220 ± 10) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert standard thermocouples type R into its heating block digestion compared to temperature obtained from reference standards thermometer at calibrated point.
- The temperature scale used was based on ITS - 90 .
- All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with Thermocouple	34970A	HY44045578/HY41194453	TC22/0044	5-May-2023	N.M. Technical Center Laboratory
	Type R	TC#181-189 / CH#181-189			

- This certificate is traceable to international system of units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC* Description
Time of Record : Hour 30 Minute At 380 °C

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
Model: 2520 Serial No.: 91794469
Resolution: 1 °C ID No.: UAE.WAS.011/2560
Manufacturer: FOSS
Date of Calibration: 30-31 March 2023 Page 3 of 4

Calibration point: 380 °C

Calibration result:

Reporting of Temperature

Block No.	UUC* Setting (°C)	UUC* Reading (°C)	Stability (±°C)	Standard Thermometer (°C)	Uncertainty (±°C)
1	380	380	0.96	377.74	2.1
2	380	380	0.40	377.28	2.1
3	380	380	1.18	377.82	2.1
4	380	380	0.44	377.19	1.6
5	380	380	0.11	377.30	1.6
6	380	380	0.14	377.90	1.6
7	380	380	1.17	373.85	2.1
8	380	380	0.33	376.96	2.1
9	380	380	0.14	374.18	2.1
10	380	380	0.96	378.56	2.0
11	380	380	1.04	378.34	2.0
12	380	380	0.35	378.06	2.0
13	380	380	0.48	377.05	1.6
14	380	380	0.38	379.19	1.6
15	380	380	0.50	377.48	1.6
16	380	380	0.48	378.33	1.7
17	380	380	0.71	377.60	1.7
18	380	380	0.35	376.77	1.7
19	380	380	0.84	377.06	1.8
20	380	380	0.41	378.58	1.8

Note:

- UUC* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

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Kjeltec™ 8100 Distillation Unit

This IQ applies to Kjeltec™ 8100 Distillation Unit manufactured by FOSS Analytical. The installation is performed by FOSS trained service personnel.

1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical AB's Application Notes.

2 Purpose

This installation Qualification is designed to assure that:

- The Kjeltec instrument is received complete, with all required parts in good condition.
- The location of the instrument is environmentally and ergonomically suitable
- The instrument is assembled and configured correctly
- Suitable electricity and water are supplied to the instrument, see table 2 for requirements.

3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit	918 99052

Dedicated Analytical Solutions

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Fax +45 7010 3371
E-mail support@foss.dk
Web www.foss.dk

FOSS Analytical AB
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Sweden

Tel +46 42 361500
Fax +46 42 340345
E-mail support@foss.dk
Web www.foss.dk

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4 Control of Received Equipment

4.1 Verify that the correct instrument type and accessory kit items are received and in proper condition

The packing list (shipped with the instrument) specifies all the items. The installer will verify that all items are received as shipped on the packing list. For each item listed, verify that the acceptance criteria are met. If so, write "Y" in the right column of the table immediately following.

Packing List Item	Acceptance Criteria	Pass(Y/N)
Kjeltec 8100 Distillation Unit	No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Accessory kit, according to packing list	Included. No visible damage, received in undamaged FOSS Analytical's standard shipping container	Y
Handling device for digestion tube	Included. No visible damage.	Y
Tanks with level sensors for Waste, Alkali and Water	Included. No visible damage.	Y
Receiver flask	Included. No visible damage.	Y
One digestion tube 250ml	Included. No visible damage.	Y
One digestion tube 100 ml	Included. No visible damage.	Y
Tube adapter	Included. No visible damage.	Y
User manual	Kjeltec 8100 Distillation Unit	Y
Owners guide	Kjeltec 8100 Distillation Unit	Y
Quick guide	Kjeltec 8100 Distillation Unit	Y
Spare parts manual	Kjeltec 8100 Distillation Unit	Y
Application notes	AN 300 included AN 303 included	Y

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5 Installation

5.1 The equipment must be installed in a suitable location with power, water and draining available

Verify that the instrument installation site meets the acceptance criteria given in the table below. If so, write "Y" in the right column of the table immediately following.

Location Requirements	Acceptance Criteria	Pass (Y/N)
Adequate space for instrument	Dimensions 48x58x69 cm	Y
AC supply available for instrument	200-240 V 50/60Hz	Y
Current	10 A	Y
Cold water supply available	2 L/min at 30°C	Y
Drain	For cooling water and waste (depending on local waste disposal legislation)	Y
Ambient temperature	Max. 40°C	Y
Ambient humidity	Max. 80% relative	Y
Internal fuses	T10A AH	Y

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5.2 The instrument must be assembled correctly

Verify that all tubes are correct connected. If so, write "Y" in the right column of the table immediately following.

Instrument Tubing Connections	Acceptance Criteria	Pass (Y/N)
	Visual verification by installer	Y

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5.3 The instrument should be assembled and powered up

Connect the distilling unit to the power supply. Perform the start up procedure and check that the expected response is obtained. If so, write "Y" in the right column of the table immediately following.

Action	Expected Response	Pass (Y/N)
Switch on the power	The instruments start up and the self test will run. The sample counter shows the number of analysed samples since first power and the Software Version shows the version of the instruments software.	Y
	After start-up, Program 1 is loaded and the Analyse menu is displayed.	Y
Turn on the cold water tap	No visible reaction	Y
Press the "Manual" view	The Manual menu is opened	Y
Open the door with the handle, place the test tube and receiver flask in position. Close the door.		Y
Select Dilution and press Start	Water is added to the tube	Y
Select Alkali and press Start	Alkali is added to the tube	Y
Select Steam and press start	After heating up, steam is entering the tube	Y
Select Drain and press Start	The tube is drained	Y

6 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

7 IQ Documentation

Upon successful completion and recording of all instructions above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

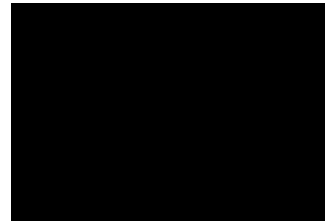
Installed By:

Company:

Customer Name:

Company:

Date completed:



FOSS

Operation Qualification

Kjeltec™ 8100 Distillation Unit

This OQ applies to Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The operation qualification is performed by FOSS trained service personnel.

1 Intended Use

Kjeltec 8100 is intended for laboratory use analyzing parameters as specified in FOSS Analytical Application Notes.

2 Purpose

This procedure is designed to test the function of the instrument according to factory test specifications:

- Alkali volume
- Distillation Accuracy
- Distillation Repeatability

3 Identification

Description	Serial Number
Kjeltec 8100 Distillation Unit, 200-240 V 50/60 Hz	91869052

4 Performance

4.1 Verify the dispensed volumes of reagents

Note! To verify the dispensed volumes of reagents a triple test should be done to be statistic correct. Then calculate a mean value.

1. Choose "Manual" in the menu. (When starting up the instrument Program 1 is loaded)
2. Open the safety door by pressing **Open** and place a tube in the instrument. Close the safety door.

Water

1. Press **Dilution** and then press **Start**. 80 ml of water will be filled into the tube.
2. Measure the collected water in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Note! If the water volume needs to be calibrated, go to 4.8.5 Dilution Pump Calibration in the User Manual.

Alkali

1. Press **Alkali** and then press **Start**. 50 ml of alkali will be filled into the tube.
2. Measure the collected alkali in a graduated measuring glass and note the result in table 1 below.
3. Check acceptance criteria in the table and make the judgment if passed or not.

Table 1 Volume control

Test	Result	Expected result	Passed (Y/N)
Water volume	83 ml 83 ml 81 ml Mean 82.67 ml	76- 84 ml	Y
Alkali volume	52 ml 52 ml 53 ml Mean 52.33 ml	47- 54 ml	Y

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E-mail support@foss.dk
Web www.foss.dk

4.2 Verify the distillation procedure, accuracy and precision

The distillation principle is to convert ammonium (NH_4^+) into ammonia (NH_3) by using an alkali (NaOH) and thereafter steam distil it into a receiver flask containing boric acid and titrate with standard acid solution using colorimetric end-point detection. Ammonium sulphate, a substance with known ammonia content, can be used to check the accuracy of the distillation. The recovery is calculated from obtained result.

The way to perform this test will be described in the following.

Chemical Check

Use ammonium sulphate ($\text{NH}_4)_2\text{SO}_4$, purity > 99.5 % *

Mol. weight = 132.14 g/mol, Nitrogen content in ammonium sulphate (99.5 %) = 21.09% *

Analysis conditions according to AN 300

Water	80 ml
Alkali	50 ml NaOH (40%w/w)
Receiver solution	30 ml boric acid (4%)
Distillation time	5 minutes
SAFE	5 seconds
Titration	0.2N HCl

For reagent preparation see Appendix A

- Start the instrument and run two blanks without chemicals according to above analysis conditions, distil into a receiver flask containing boric acid. Titrate with a standard acid solution using colorimetric end-point detection. If the blanks are less than 0.2 ml continue with the recovery tests:
- Weigh 0.15 g ammonium sulphate into a tube. Prepare 6 samples (tubes).
- Run the six samples according to above analysis conditions. Titrate with a standard acid solution using colorimetric end-point detection.
- Calculate the recovery according to below equations. Expected results of recovery should be 100%±1%.

Recovery test	Result	Expected result	Passed (Y/N)
Blank value (water blank)	1. 0.03 ml 2. 0.14 ml	0.05-0.20 ml	Y
Recovery	1. 100.5% 2. 100.3% 3. 100.6% 4. 99.8% 5. 99.9% 6. 100.0%		
Accuracy	Mean Value: 100.0%	99-101%	Y
Precision	SD: 0.55%	SD <1%	Y

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*) Note! Please also note that the below calculations must be adjusted if other purity levels of ammonium salts are used. A certificate for the chemical supplier should be available

Purity	Nitrogen content
99.5%	21.09%
99.6%	21.12%
99.7%	21.14%
99.8%	21.16%
99.9%	21.18%

$$\% \text{ Nitrogen} = \frac{(ml_{\text{sample}} - ml_{\text{blank}}) \times N \times 14,007 \times 100}{mg_{\text{sample}}} \quad 0.1095 \quad 21.72$$

N = Normality of titrant to 4 places of decimal.

$$\% \text{ Recovery} = \frac{\% \text{ Nitrogen}}{21.09} \times 100$$

mg sample

① 0.159g 23.56

②

③

④

⑤

⑥

5 Summary of Deviations/Comments

Deviations from above requirements are specified below and any corrective actions are noted.

Deviation	Action	Comment

6 OQ Documentation

Upon successful completion of tests above, sign and date this sheet below. If required by customer, leave one signed copy with instrument.

If customer's internal procedures require further reporting or witnessing of results, execute those procedures as required.

Performed By: _____

Company: _____

Customer Name: _____

Company: _____

Date completed: _____

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7 Appendix A

7.1 Preparation of Reagents

7.1.1 Alkali

To convert ammonium into ammonia an excess of sodium hydroxide is necessary.

Use 400 g NaOH per litre of solution. Commercially available in concentrations up to 50 %. Do not use concentrations above 40 % as this will lead to crystal formation impairing the function of the pumps. If you can only buy concentrations > 40 %, dilute it before use.

7.1.2 Titrant acid, determination of concentration

To be able to achieve accurate nitrogen / protein results, one must be quite sure that the HCl (hydrochloric acid) concentration is what it is supposed to be. A titration against a predetermined solution of sodium carbonate as described below is thus necessary. Incorrect HCl concentration can otherwise cause substantial errors.

- Standard substance**
Weigh approx. 10 g of anhydrous sodium carbonate (Na_2CO_3). Use a mortar to make a fine powder. Dry it for 1 h at 265 °C or 2 h at 200 °C. After cooling in a desiccator, transfer the sodium carbonate to a beaker with a tight lid. Store it in a desiccator.
- Indicator solutions**
Dissolve 0.1 g methyl red in 100 ml methanol. Dissolve 0.1 g bromocresol green in 100 ml methanol.
- Procedure**
Weigh approx. 0.4 g of the standard substance, using an analytical balance, note the weight (W_1). Transfer the sodium carbonate to a receiver flask and add 40 ml of H_2O (distilled or deionized). Add 8 drops from each of the indicator solutions. Titrate to pink. Note the amount in ml used (A_1). Boil this solution for a few minutes. The solution will turn green. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour change occurs. Note also this volume (A_2). Boil the solution for a few minutes. Cool rapidly to room temperature under running water. Continue the titration until the next pink colour occurs. Note also this volume (A_3).
Note! Temperature changes will influence the volume and the concentration of the titrant solution. The working temperature of the titrant should approximate that of its temperature during standardization. If temperature corrections are necessary, sufficient accuracy may be obtained by use of a correction table. (AOAC 942.25)

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7.2 Calculation

$$\text{Molarity (M)} = \frac{18,870 \times W_1}{(A_1 + A_2 + A_3)}$$

Note! Concentration must be accurate to four digits, i.e. 0.2000 M.

Note! The colour change of this official procedure (AOAC 936.15) may be difficult to see, therefore a pH meter or a mixed indicator (e.g. 0.1 g Methyl red and 0.1 g Bromocresol green in 100 ml methanol) will make it much easier to perform.

7.3 Receiver Solution

Boric acid 4 % with bromocresol green / methyl red indicator solution

In order to obtain accurate results the receiver solution is adjusted so that a small (0.05-0.20 ml) positive blank is obtained when running a blank sample. The 4 % boric acid receiver solution is prepared by dissolving 400 g of boric acid in about 5-6 l very hot deionized water. Mix and add more hot deionized water to a volume of about 9 l. Cool the solution to room temperature and add 100 ml of bromocresol green solution (100 mg in 100 ml methanol) and 70 ml of methyl red solution (100 mg in 100 ml of methanol). Dilute to 10 l with deionized water and mix carefully.

Note! The addition of alkali is to achieve a positive blank value. This should, however, be kept between 0.05 - 0.20 ml titrant, to obtain good repeatability when testing blanks.

Adjustment of the boric acid is made by the following procedure:

1. Transfer 25 ml boric acid solution to a receiver flask and add 100 ml of distilled water. If the solution in the flask is still red, titrate with 0.1 M sodium hydroxide solution until a neutral grey colour is obtained. Calculate the amount of sodium hydroxide solution necessary to adjust the boric acid solution in the 10 l flask with the formula: ml 1.0 M alkali = ml titrant x 40
2. Add the calculated amount of 1.0 M alkali solution to the boric acid solution. Mix.
3. To check proceed as follows using 25 ml of the boric acid solution. Run a blank. If the value of this blank is high (0.5 ml of 0.2 M HCl) the boric acid is incorrectly adjusted. This might create irregular blanks. For correction add HCl directly into the boric acid tank, mix it carefully and repeat until a reading of 0.05 - 0.20 ml HCl is obtained. If a positive blank is not achieved, add further small quantities of 1 M NaOH and repeat the check until a satisfactory value is achieved.

4.2 Ongoing Qualification Tests

Block Temperature

The temperature for the digestion is limited by the boiling point for the sulphuric acid, this can be increased by adding a salt (K_2SO_4) to the digestion mixture. It's important that the optimal ratio between acid and salt is kept; please follow recommendation in AN 300 or suggested procedures for a specific kind of sample material.

The block temperature itself can be controlled external by inserting a temperature probe in the intended hole in the aluminium block (front row of holes).

Use the reagents and method procedure specified in AN 300. Use only reagents of recognized analytical grade, unless otherwise specified and distilled or demineralised water or water of equivalent purity.

Suggested standard material for internal quality control:

Ammonium sulphate $[(NH_4)_2SO_4]$, min. 99.5 % (mass fraction), with certified purity.

Note: The above chemical is usually readily available with a certificate specifying the purity.

Alternatively ammonium iron(II) sulphate, $(NH_4)_2 Fe (SO_4)_2 \times 6 H_2O$, with certified purity may be used.

Tryptophan ($C_{11}H_{12}N_2O_2$), minimum assay 99 % (mass fraction). Nitrogen content 137.2 g/kg. Do not dry in an oven before use.

Acetanilide (C_8H_9NO), minimum assay 99 % (mass fraction). Nitrogen content 103.6 g/kg. Do not dry in an oven before use.

Sucrose, ($C_{12}H_{22}O_{11}$), with a nitrogen content of not more than 0.002 % (mass fraction). Do not dry in an oven before use.

Blank Tests

Carry out a blank test following the currently used procedure for digestion, distillation and titration taking 2 ml of water and about 0.7 g of sucrose instead of the test portion. Keep a record of blank values. If blank values change, identify the cause.

Note: The amount of titrant used in the blank test should always be greater than 0.0 ml. Blanks within the same laboratory should be consistent across time.

4.3 Recovery Tests

Regularly run recovery studies to check the accuracy of procedure and equipment:

- **Nitrogen loss.** - Use 0.12 g ammonium sulphate and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Add all other reagents as stated in the method currently used (Kjeltabs, H_2SO_4 , etc). Digest and distil under same conditions as for sample. Recoveries shall be >99 %.
- **Digestion efficiency.** - Use a test portion of minimum 0.15 g of tryptophan or acetanilide and 0.67 g sucrose per flask weighed to the nearest 0.1 mg. Determine the nitrogen content according to the current procedure in use. The recoveries of tryptophan shall be >98.5 %; the recoveries of acetanilide shall be >99.5 %.
- **Distillation and titration efficiency.** - Distil 0.10 - 0.15 g ± 0.0001 g ammonium sulphate, omitting the digestion step. The recoveries should be >99.5 %.

Note: Results less than 98.5 % or more than 101.0 % in either of the recovery tests indicate failures in the procedure and/or inaccurate concentration of the standard volumetric hydrochloric acid solution (should be adjusted to four decimals accuracy according to procedure in AN 300)

Kjeltec™ 8100 Distillation Unit Tecator™ 2508/2520 Digestor

1 Scope

This PQ applies to the Digestion system 2508/2520 (including exhaust and scrubber unit) and Kjeltec 8100 Distillation Unit manufactured by FOSS Analytical. The user of the instrument performs the PQ.

2 Intended Use

The Digestion system (including exhaust and scrubber) and Kjeltec 8100 Distillation Unit are intended for laboratory use analyzing parameters as specified in FOSS Application Notes.

3 Purpose

The guidelines are intended to assist the user in successfully developing Performance Qualifications for the specific application(s) to which the instrument is applied.

The Performance Qualification (PQ) includes the process of demonstrating that the Digestion system 2508/2520 (including exhaust and scrubber unit) and the Kjeltec 8100 Distillation unit consistently perform according to a specification appropriate for its routine use. Main activities in the PQ phase are:

- Preventive maintenance
- On-going verification tests

This document suggests routines to fulfill the requirements for an acceptable PQ but the final procedure should be adapted to local routines for similar equipment.

4 Definition of Test Procedures

4.1 Preventive Maintenance

Maintenance of the Kjeltec 8100 should be performed according to the instructions in manual, see User Manual Kjeltec 8100/8200 Distillation Unit, chapter 5. Maintenance. A yearly service is recommended (service agreement).

Maintenance of the Digestion block (including exhaust and scrubber) should be performed according to instruction in the user manual, see User Manual Tecator Digestor, chapter 5. Maintenance.

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Web www.foss.dk

External Quality Control Program

It is recommended to participate in an external quality control program, such a proficiency program or ring test, with equivalent sample material as analysed within the laboratory.

Calculation and Expression of Results

$$W_N = \frac{14.007(V_s - V_b)N \times 100\%}{m}$$

Where:

W_N is the nitrogen content of the sample, expressed as a percentage by mass.

V_s is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the sample test, in milliliters, expressed to the nearest 0.05 ml.

V_b is the numerical value of the volume of the hydrochloric acid standard volumetric solution used in the blank test, in milliliters, expressed to the nearest 0.05 ml.

N is the numerical value of the exact normality of the hydrochloric acid standard volumetric solution, expressed to four decimal places.

m is the numerical value of the mass of the test portion, in milligrams, expressed to the nearest 1 mg for sample weights >1 g or to the nearest 0.1 mg for sample weights <1 g.

5 Maintenance

5.1 Maintenance Kjeltec™ 8100

See instructions in User Manual - Kjeltec 8100/8200, chapter 5 Maintenance.

5.2 Maintenance Tecator™ Digestor

See instructions in User Manual - Tecator Digestor, chapter 5 Maintenance.

6 The Maintenance Record Charts

This record charts are provided to assist you in keeping your system in good working order. Please make copies and use them regularly as they can often help us to help you in the unlikely event a system malfunction.

6.2 FossCare™ Customer Log

6.2.1 Daily Maintenance

[illegible]

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6.1 FossCare™ Service Log

[illegible]

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6.2.2.2 Weekly Maintenance

[illegible]

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Applicable for FOSS sales and service companies.

Applicable for FOSS sales and service companies.

6.2.5 Yearly Maintenance

[illegible]

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6.2.3 Every 1-3 Months Maintenance

[illegible]

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6.2.6 Exchange of Parts and Reagents Maintenance

[illegible]

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6.2.4 Additional Maintenance

[illegible]

เอกสารไม่ควบคุม