

## ภาคผนวก จ

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ใบรับรองการสอบเทียบเครื่องมือ

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

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

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Stack</b>									
1	Pre-Test Console	Total Suspended Particulate Methanethiol Dimethyl Sulfide	Apex Instruments, USA.	XC-572-V 0807047	Envi Equipment Service Co., Ltd.	E22-08028	4 Aug 22	3 Aug 23	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo AG	Testo 350 62289477	Entech Industrial Solutio Co., Ltd.	G 650654	28 Sep 22	27 Sep 23	-

### List of Opacity Training Certification for Opacity Measurement

No.	Name	Training Course	Train	Date	Remark
1	Mr.Noppasin Thanuthammarat	Opacity	Pollution Control Department	30-31 March 2017	-
2	Mr.Ronnapob Putragulpattana	Opacity	Pollution Control Department	22-23 March 2018	-

### List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
<b>Water</b>									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA0D0081	Technology Promotion Association (Thailand-Japan)	23CH6	5 Jan 23	4 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE0H0003	Technology Promotion Association (Thailand-Japan)	23TW1	5 Jan 23	4 Jan 24	-
3	Conductivity Meter	Conductivity	Horiba	LAQUA-EC210 HC0J0020	Technology Promotion Association (Thailand-Japan)	22CH8	5 Jan 23	4 Jan 24	-

CERTIFICATE OF CALIBRATION

**Customer** : United Analyst and Engineering Consultant Co., Ltd.  
**Address** : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
**Description of Equipment** : Console meter  
**Manufacturer** : Apex Instrument  
**Model Number** : XC-572-V  
**Serial Number** : 0807047  
**ID./Control No.** : -  
**Environment Conditions** : Temperature (25 ± 2) °C  
: Humidity (50 ± 15) % RH  
**Cal. Date** : 04/08/2022  
**Issue Date** : 04/08/2022

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved: [Signature]  
(Mr. Mana Fuekhuay)  
Technical Manger

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METHOD 5 CONSOLE CALIBRATION  
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425  
5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions			Factors/Conversions			
Console Model Number	XC-572-V	Date	Time	04/08/2022	10:15 AM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	E22-08028		Std Press	760	mm Hg	
DGM Model Number	SK25EX	Barometric Pressure	756.74		K <sub>i</sub>	0.386		
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		Console Leak Check	PASS		

Run Time	Metering Console					Calibration Meter			
	DGM Orifice	Volume	Volume	Outlet Temp	Outlet Temp	Volume	Volume	Outlet Temp	Outlet Temp
Elapsed (Q)	DH (P <sub>a</sub> )	Initial (V <sub>in</sub> )	Final (V <sub>out</sub> )	Initial (t <sub>in</sub> )	Final (t <sub>out</sub> )	Initial (V <sub>wf</sub> )	Final (V <sub>wf</sub> )	Initial (t <sub>w</sub> )	Final (t <sub>w</sub> )
min	mm H <sub>2</sub> O	m <sup>3</sup>	m <sup>3</sup>	°C	°C	m <sup>3</sup>	m <sup>3</sup>	°C	°C
12.08	13.0	390.8550	390.9950	25	25	78.65900	78.78940	26	26
12.08	13.0	390.9950	391.1350	25	25	78.78940	78.91882	26	26
8.32	26.0	391.1420	391.2820	25	25	78.92544	79.05734	26	26
8.30	26.0	391.2820	391.4220	25	25	79.05734	79.18906	26	26
13.68	40.0	391.4300	391.7100	26	26	79.19648	79.45922	26	26
13.63	40.0	391.7100	391.9900	26	26	79.45922	79.71978	26	26
10.05	70.0	392.0060	392.2860	27	27	79.73482	79.99894	25	25
10.02	70.0	392.2860	392.5660	28	28	79.99894	80.26136	25	25
8.83	90.0	392.5830	392.8630	29	29	80.27706	80.53782	25	25
8.80	90.0	392.8630	393.1430	29	29	80.53782	80.79854	25	25



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Meter Console Information		Calibration Conditions			Factors/Conversions			
Console Model Number	XC-572-V	Date	Time	04/08/2022	10:15 AM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	E22-08028		Std Press	760	mm Hg	
DGM Model Number	SK25EX	Barometric Pressure	756.74		K <sub>i</sub>	0.386		
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		Console Leak Check	PASS		

Calibration Data										
Results										
Standardized Data				Dry Gas Meter						
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate		Variation		
(V <sub>inst</sub> )	(Q <sub>inst</sub> )	(V <sub>w(inst)</sub> )	(Q <sub>w(inst)</sub> )	(Y)	(ΔY)	(Q <sub>std(Conn)</sub> )	(ΔH <sub>g</sub> )	(ΔH <sub>g</sub> )	(ΔH <sub>g</sub> )	
m <sup>3</sup>	m <sup>3</sup> /min	m <sup>3</sup>	m <sup>3</sup> /min			m <sup>3</sup> /min	mm H <sub>2</sub> O	mm H <sub>2</sub> O	mm H <sub>2</sub> O	
0.137	0.011	0.127	0.011	0.929	-0.001	0.011	51.819	2.411		
0.137	0.011	0.126	0.010	0.922	-0.007	0.010	52.607	3.198		
0.137	0.016	0.129	0.015	0.939	0.009	0.015	48.107	-1.302		
0.137	0.016	0.128	0.015	0.938	0.008	0.015	48.045	-1.363		
0.274	0.020	0.256	0.019	0.934	0.004	0.019	50.628	1.220		
0.274	0.020	0.254	0.019	0.926	-0.004	0.019	51.103	1.695		
0.276	0.027	0.258	0.026	0.936	0.006	0.026	47.412	-1.996		
0.276	0.028	0.257	0.026	0.930	0.000	0.026	47.711	-1.698		
0.277	0.031	0.255	0.029	0.922	-0.008	0.029	48.501	-0.908		
0.277	0.031	0.255	0.029	0.922	-0.008	0.029	48.150	-1.258		
				0.930	Y Average			49.408	ΔH <sub>g</sub> Average	

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.  
For ΔH<sub>g</sub>, orifice pressure differential that equates to 0.75 cfm (0.0212 m<sup>3</sup>/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H<sub>2</sub>O.



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Meter Console Information		Calibration Conditions			Factors/Conversions			
Console Model Number	XC-572-V	Date	Time	04/08/2022	10:15 AM	Std Temp	293	K
Console Serial Number	0807047	Calibration Reference No.	E22-08028		Std Press	760	mm Hg	
DGM Model Number	SK25EX	Barometric Pressure	756.74		K <sub>i</sub>	0.386		
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		Console Leak Check	PASS		



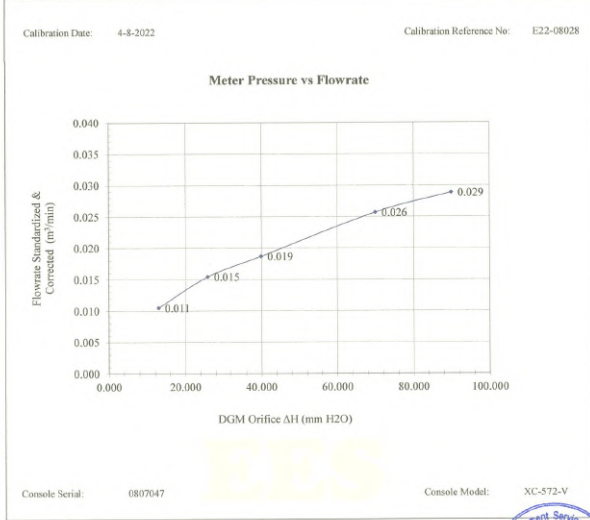
Console Serial: 0807047

Console Model: XC-572-V



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Meter Console Information		Calibration Conditions		Factors/Conversions	
Console Model Number	XC-572-V	Date	04/08/2022 10:15 AM	Std Temp	293 K
Console Serial Number	0807047	Calibration Reference No.	E22-08028	Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	756.74 mm Hg	K <sub>1</sub>	0.386
DGM Serial Number	00003580	Calibration Meter Gamma	0.999	Console Leak Check	PASS



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**THERMOCOUPLES SYSTEM CALIBRATION**

Sampling System Equipment Information		Calibration Conditions	
Console Model Number	XC-572-V	Date	04/08/2022 12:30 PM
Console Serial Number	0807047	Calibration Reference No.	E22-08028
DGM Model Number	SK25EX	Reference Thermometer	DIGICON
DGM Serial Number	00003580	Serial Number	183169105
Meter Box Model Number	JENCO 765 KF		
Meter Box Serial Number	JC 17073		

Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-20.0	25.0	38.0	94.0	150.0	258.0	369.0	480.0	591.0	814.0	1036.0
Aux	-20.0	25.0	38.0	94.0	150.0						
Probe	-20.0	25.0	38.0	94.0	149.0						
Filter	-20.0	25.0	38.0	94.0	150.0						
Exit	-20.0	25.0	38.0								

Tolerance Range		Meter
Stack	± 1.50% Absolute	± 3.0 °C
Probe	± 3.0 °C	± 2.0 °C
Filter	± 3.0 °C	



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**Instrument description** : Flue gas Analyzer  
**Instrument model** : Testo 350 New  
**Instrument serial no.** : 62289477  
**ID no. or control no.** : UAE.EFM.090/2563  
**Manufacturer** : Testo SE & Co. KGaA  
**Probe description** : -  
**Probe model** : -  
**Probe serial** : -  
**Customer name** : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
**Customer address** : 81 SOI UDOMSUKH1,SUKHUMVIT ROAD,BANGCHAK PRAKANONG BANGKOK 10260

**Total pages of certificate** : 3 Pages  
**Receiving no.** : L-223346  
**Receiving date.** : 22-Sep-22  
**Parameter of calibration** : Gas Calibration(Oxygen 2.498,10.00,21.00 %Vol, Carbon Monoxide 80.16,309.9,1003 ppm, Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.9,601.1 ppm, )

**Condition of UUC.** : Used  
**Ambient condition** : All of the Measurement were carried out the stabilized laboratory  
Temperature : 23 ±5 °C  
Humidity : 55 ± 15 %RH  
**Calibration place** : 17/121 Soi Ngamwongwan 47 Yeak 48, Toongsonghong, Laksi, Bangkok 10210

**Calibration procedure no.** : WI-CL-28-C  
*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition. This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid. This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).*  
**Date of calibration** : 28-Sep-22

Mr. Sedtawut Nualthong  
Calibration Technician

Mrs. Nongluck Wangsettee  
Technical Manager

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**Standard References (Table 1)**

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen ( O <sub>2</sub> ) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen ( O <sub>2</sub> ) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide ( CO ) 80.16 ppm	2582/22	Linde	08-Aug-24
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 202.2 ppm	3239/21	Linde	20-Jul-23
Nitric Oxide ( NO ) 30.08 ppm	553100608	Nimet	13-Jun-24
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide ( NO ) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 100.9 ppm	4942/20	Linde	20-Nov-22
Sulphur Dioxide ( SO <sub>2</sub> ) 601.1 ppm	3204/21	Linde	20-Jul-23

**Measured room conditions**  
Temperature : 22.5 °C Humidity : 55.6 %RH Pressure : 1012.6 mbar  
**Calibration conditions**  
Gas Temperature : 23 °C Flow rate : 1200 ml/min Gas pressure : 1021.4 mbar

**Calibration Results Before Adjustment (Table 2)**

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (+)
	O <sub>2</sub> (%Vol)	2.498	2.51	0.012
O <sub>2</sub> (%Vol)	10.00	9.85	-0.15	0.40
O <sub>2</sub> (%Vol)	21.00	21.09	0.08	0.80
CO (ppm)	80.16	80	-0.16	3.0
CO (ppm)	309.9	309	-0.9	6.0
NO <sub>2</sub> (ppm)	1003	1003	0	12
NO <sub>2</sub> (ppm)	30.34	32.1	1.76	8.0
NO <sub>2</sub> (ppm)	80.96	78.5	-2.46	8.0
NO <sub>2</sub> (ppm)	202.2	199.4	-2.8	12
NO (ppm)	30.08	25	-5.08	8.0
NO (ppm)	150.9	147	-3.9	8.0
NO (ppm)	320.6	310	-10.6	12
SO <sub>2</sub> (ppm)	50.04	46	-4.04	6.0
SO <sub>2</sub> (ppm)	100.9	95	-5.9	6.0
SO <sub>2</sub> (ppm)	601.1	573	-28.1	13

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Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.51	0.012	0.20
O2 (%Vol)	10.00	9.85	-0.15	0.40
O2 (%Vol)	21.00	21.09	0.08	0.80
CO (ppm)	80.16	80	-0.16	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1003	0	12
NO2 (ppm)	30.34	32.1	1.76	8.0
NO2 (ppm)	80.96	78.5	-2.46	8.0
NO2 (ppm)	202.2	199.4	-2.8	12
NO (ppm)	30.08	29	-1.08	8.0
NO (ppm)	150.9	151	0.1	8.0
NO (ppm)	320.6	322	1.4	12
SO2 (ppm)	50.04	50	-0.04	6.0
SO2 (ppm)	100.9	102	1.1	6.0
SO2 (ppm)	601.1	604	2.9	13

Remark : 1 cmol/mol = 1 %vol. , 1 µmol/mol = 1 ppm.

End of Report



Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Horiba  
Model : LAQUA-PH210  
Serial No. : HA000081  
ID No. : UAE\_EFM.074/2564(EFM pH.07/64)  
Condition As-Received: Used Item  
Received Date : 04 January 2023  
Calibration Date : 05 January 2023  
Reference : 2301-0060WSC-2  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong, Bangkok 10260  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In - house method :  
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH6 by comparison with standard thermometer

Calibrated by : Sathip Meangmai

Approved by :

(/ ) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemngagrakul

Issue Date : 10 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the local of Corporate Services & Engineering Calibration and Testing Services

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Condition of this calibration result

1 Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4962054	110RC044	22I1306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.009	CPA chem	826588	09 July 2024
pH 6.887	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	829590	09 July 2023

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4.7)(7.10)

Unit Under Calibration	Nominal Value		Standard Voltage Input		Actual Reading	Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH			
pH Meter S/N.: HA000081	4.00	177.48	177.4	4.01	0.058	2.00	
	7.00	0.00	0.1	6.98	0.058	2.00	
	7.00	0.00	0.1	6.98	0.058	2.00	
	10.00	-177.48	-177.4	10.01	0.058	2.00	

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Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.7)(7.10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 990C0039	4.008	4.01	138.5	0.0085	2.05
	6.997	6.98	-32.1	0.011	2.00
	6.987	7.00	-33.1	0.011	2.00
	10.008	10.03	-205.2	0.0096	2.00

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652  
- Serial No. : 990C0039

Dimension of probe:

- Length : 102 mm.  
- Diameter : 15.5 mm  
- Immersion Depth : 85 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.004	25.0	-0.004	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.003	35.0	-0.003	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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Cert.No.: 23TW1  
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### Certificate of Testing

**Equipment :** DO Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-DO210  
**Serial No. :** HE0H0003  
**ID No. :** UAE.EFM.083/2564(EFM.DO.02/64)  
**Received Date :** 04 January 2023  
**Test Date :** 05 January 2023  
**Reference :** 2301-0081WSC-1  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260  
**Laboratory Condition :** Temperature ( 25 ± 5 ) °C  
Humidity ( 50 ± 20 ) %  
**Test Procedure :** In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method  
**Tested by :** Walalak Sirithean  
**Approved by :** [Redacted Signature]  
Approved Signatory  
( ✓ ) Malee Bulkrusa  
( ) Salitip Meangmal  
( ) Warakorn Lemgagatrakul  
**Issue Date :** 6 January 2023

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Cert.No.: 23TW1  
Page.: 2 of 2

### Condition of this result of calibration

1. Reference Standard Instruments :  
This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette		130BU10	21CG1389	25 Mar 2023
2) Balance	1126149764	140RC004	22MM50	20 Sep 2023

### 2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %  
Dissolved Oxygen Probe No.: 9K0E0260

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.14	8.14	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned Inland to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full without written approval of the laboratory

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Cert. No.: 23LM1  
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### Certificate of Calibration

**Equipment :** DO Meter With Sensor  
**Manufacturer :** Horiba  
**Model :** LAQUA-DO210  
**Serial No. :** HE0H0003  
**ID No. :** UAE.EFM.083/2564(EFM.DO.02/64)  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
**Location :** TPA On Site Calibration Laboratory  
**Received Order :** 4 January 2023  
**Calibrated Date :** 6 January 2023  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %  
**AC Line Voltage :** ( 220 ± 22 ) V  
**Calibrated by :** Malee Bulkrusa  
**Approved by :** [Redacted Signature]  
Approved Signatory  
( ) Pornthiappa Tamayakul  
( ✓ ) Suwit Imjai  
**Issue Date :** 10 January 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced either in full or except as the price may be.  
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services

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**Equipment :** DO Meter With Sensor  
**Condition As-Received :** Used Item  
**Reference :** 2301-0081WSC-2  
**Cert. No.:** 23LM1  
**Page:** 2 of 2

### Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPT ) into Temperature Bath.

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) Digital Thermometer	1523	2188080	2211285	21 Oct 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 :** Temperature measurement

This instrument was connected with temperature sensor, S/N : 9K0E0260

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
25.0	80	25.003	25.0	-0.003	0.16	2.00
30.0	80	30.010	29.9	-0.110	0.16	2.00
35.0	80	34.996	34.9	-0.096	0.16	2.00

UUC\* : Unit Under Calibration


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

-c06-

เอกสารไม่ควบคุม



## Certificate of Calibration

**Equipment :** Conductivity Meter  
**Manufacturer :** Horiba  
**Model :** LAQUA-EC210  
**Serial No. :** HCOJ0020  
**ID No. :** UAE.EFM.078/2564(EFM.SCT.04/64)  
**Condition As-Received:** Used Item  
**Received Date :** 04 January 2023  
**Calibration Date :** 05 January 2023  
**Reference :** 2301-0059WSC-2  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Sol Udomsuk 41, Sukhumvit Road, Bangchak,  
Phraekhanong, Bangkok 10260  
**Ambient Temperature :** (25 ± 2.5) °C  
**Relative Humidity :** (50 ± 15) %  
**Calibration Procedure:** In-house method :  
- CP-CH6 by direct measurement  
with certified reference material (CRM)  
- CP-CH6 by comparison with standard thermometer  
**Calibrated by :** Walailak Sinithean  
**Approved by :**   
Approved Signatory  
✓ Maluee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul  
**Issue Date :** 10 January 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.

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### Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	221484	17 Apr 2023
2) Ref. Std. Thermometer	4982054	110RC044	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accredited Board, Accredited No. AB-1635

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 µS/cm	CPA Chem	823328	20 June 2023
12.880 mS/cm	CPA Chem	823329	20 June 2023

- Control Conductivity calibration solution temperature by Water bath (25±0.1) °C

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

### Calibration results

Function : Conductivity Measurement

(\* ) After Adjustment at 1413.0 µS/cm

Conductivity Electrode Serial No.: 9B0K0167

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1413.0 µS/cm	1297 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12.880 mS/cm	11.54 mS/cm	12.88 mS/cm	0.096 mS/cm	2.00

Remark - UUC\* = Unit Under Calibration

เอกสารไม่ควบคุม



### Calibration Results

Function : Temperature Measurement

(\* ) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9383  
- Serial No. : 9B0K0167

Dimension of probe;

- Length : 104 mm.  
- Diameter : 16 mm.  
- Immersion Depth : 90 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)	Coverage factor k
25.0	25.000	25.0	0.000	0.13	2.00
30.0	29.999	30.0	0.001	0.13	2.00
35.0	34.999	35.0	0.001	0.13	2.00

Remark : - UUC\* = Unit Under Calibration

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

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เอกสารไม่ควบคุม

งานติดตามตรวจสอบคุณภาพสิ่งแวดล้อม

โครงการโรงไฟฟ้าพลังความร้อนร่วม (74 เมกกะวัตต์)

บริษัท เนชั่นเนล เพาเวอร์ แพลนท์ 5A (สาขา1) จำกัด

ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2566

### รายการใบรับรองสอบเทียบทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือสำหรับวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละออง (TSP)	Mettler-Toledo	AB204-S / 1128312528	Mettler-Toledo (Thailand) Ltd.	23MM331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)		Mettler-Toledo	AB204-S/FACT / B108115858	Mettler-Toledo (Thailand) Ltd.	23MM332	7 Apr 23	5 Apr 24	-

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



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

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** AB204-S  
**Serial No. :** 1128312528  
**ID No. :** UAE.AIR.019/2550  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260

**Location :** Balance Room 2

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

**Calibrated by :** Suwit Imjai

**Approved by :**

( ) Pornthippa Tameyakul  
(/ ) Malee Butkruea

**Issue Date :** 10 April 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.

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**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-00150C-1

Cert.No.: 23MM331  
Page: 2 of 3

**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-0B01 according to direct measurement method against standard weight.

### Condition of this result of calibration

1. Reference standard instruments-

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

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

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

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

Before Adjustment :	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
	100	+0.0001	0.19	2.03
	200	-0.0001	0.29	2.00

**After Adjustment :**

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

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

เอกสารไม่ควบคุม

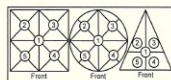


**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2304-00150C-1

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

### 2. Effect of off center loading

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



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

### 3. Departure from nominal value

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

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

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เอกสารไม่ควบคุม



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

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** AB204-S /FACT  
**Serial No. :** B108115858  
**ID No. :** UAE.AIR.019/2555  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260

**Location :** Balance Room 2

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

**Calibrated by :** Suwit Imjai

**Approved by :**

( ) Pornthippa Tameyakul  
(/ ) Malee Butkruea

**Issue Date :** 10 April 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.

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

Cert.No.: 23MM332  
 Page: 2 of 3

**Procedure used :-**

Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

**Condition of this result of calibration**

1. Reference standard instruments-

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

**Result of calibration** ( ) Without Adjustment ( \* ) After Adjustment by Internal Calibration  
 Range capacity : 0 g to 220 g Resolution 0.0001 g

**Before Adjustment :**

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

**After Adjustment :**

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

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

เอกสารไม่คว [Redacted]



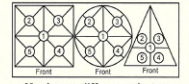
Equipment : Electronic Balance  
 Condition As-Received : Used Item  
 Reference : 2304-0015OC-2

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

**Result of calibration**

2. Effect of off center loading

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



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

3. Departure from nominal value

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

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

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เอกสารไม่คว [Redacted]

งานติดตามตรวจสอบคุณภาพสิ่งแวดล้อม

โครงการโรงไฟฟ้าพลังความร้อนร่วม (74 เมกกะวัตต์)

บริษัท เนชั่นแนล เพาเวอร์ แพลนท์ 5A (สาขา1) จำกัด

ระหว่างเดือนมกราคม-มิถุนายน พ.ศ. 2566

### รายการใบรับรองสอบเทียบทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือสำหรับวิเคราะห์คุณภาพน้ำทิ้ง และน้ำใต้ดิน									
1	pH Meter	ความเป็นกรด-ด่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1231155210	National Food Institute, Ministry of Industry, Thailand	2301846-001-01	24 Feb 23	23 Feb 24	-
2	pH Meter		Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	22 Mar 24	-
3	Conductivity Meter	ความนำไฟฟ้า (Conductivity)	SI Analytics	Lab955 / 16300356	SPC Calibration Center Co.,Ltd.	C24230059	16 Mar 23	14 Mar 24	-
4	UV-VIS Spectrophotometer	ฟอสเฟต (PO <sub>4</sub> <sup>3-</sup> ) ไนเตรท (NO <sub>3</sub> )	Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	6 Jan 23	5 Jan 24	-
5	UV-VIS Spectrophotometer		Hitachi	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP23-008	6 Jan 23	5 Jan 24	-
6	Atomic Absorption Spectrophotometer (AAS)	Iron (Fe) Manganese (Mn)	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Thailand Institute Of Science And Technological Research (TISTR)	MTC.ACL. No. 486/65	7 Mar 22	6 Mar 23	-

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

### Calibration Certificate

**Certificate No.:** 2301846-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhonng, Bangkok 10260

Page 1 of 5

**Equipment:** pH Meter  
**Manufacturer:** Mettler Toledo  
**Model:** SevenEasy TM S20 pH  
**Serial No.:** 1231155210  
**ID No.:** UAE.WAT.010/2553  
**Order No.:** 2301846  
**Operation No.:** 2301846-001  
**Date of Receipt:** 17 February 2023  
**Date of Calibration:** 24 February 2023

**Calibrated by** Mr.Worapob Seoktong Approved [Redacted]  
Scientist ( Mr.Nuttapol Niyomchart )  
Specialist, Division of Calibration Laboratory  
Responsible for the Technical Management Team  
**Date of Issue:** 24 February 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-CS-009 Revision: 01 Date: 20-04-65

### Calibration Report

**Certificate No.:** 2301846-001-01  
**Equipment:** pH Meter  
**Resolution:** 0.01 pH ; 1 mV  
**Manufacturer:** Mettler Toledo  
**Model:** SevenEasy TM S20 pH  
**Serial No.:** 1231155210  
**Type:** Bench top  
**ID No.:** UAE.WAT.010/2553

Page 2 of 5

**Date of Calibration:** 24 February 2023  
**Location:** Chemical Calibration Laboratory, National Food Institute  
**Environment Condition:** Ambient Temperature: ( 25.1 ± 1.5 ) °C Relative Humidity: ( 50 ± 5 ) %  
**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	Fluke	2281959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC 650577-01	30 October 2023
2.3 Thermo-Hygro Meter	NFLBTH 007/18	POMPE 490	CR22-0886	28 April 2023
Certified Reference Material				
	Lot No.	Manufacturer	Ref. N	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	832006	CPAchem	PH218.L5	8 August 2024
2.5 pH buffer 6.865 (Primary pH buffer Solution)	832007	CPAchem	PH217.L5	8 August 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	832009	CPAchem	PH220.L5	8 August 2023
2.7 pH buffer 7.00 (Standard pH buffer Solution)	832010	CPAchem	PH107.L5	8 August 2023
3. This certification is traceable to The International System of Unit (SI Unit)
  - 3.1 Instruments No.2.1 through NSIC-TS18.17025 Laboratory Accreditation of Calibration No.0086
  - 3.2 Instruments No.2.2 through NSIC-TS18.17025 Laboratory Accreditation of Calibration No.0061
  - 3.3 Instruments No.2.3 through NSIC-TS18.17025 Laboratory Accreditation of Calibration No.0292
  - 3.4 Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method: Normal call 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 BSM RefN H-27 LotN 04.06.2021; BM RefN H-28 LotN 28.05.2021; BM RefN H-27 LotN 04.06.2021; BM RefN H-28 LotN 28.05.2021, 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.:** 2301846-001-01  
**Equipment:** pH Meter  
**Resolution:** 0.01 pH ; 1 mV  
**Manufacturer:** Mettler Toledo  
**Model:** SevenEasy TM S20 pH  
**Serial No.:** 1231155210  
**Type:** Bench top  
**ID No.:** UAE.WAT.010/2553

Page 3 of 5

**Date of Calibration:** 24 February 2023  
**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	285.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.100	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	-285.811	-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.:** 9018311  
**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	186	-	0.0071	2.00
6.865	6.90	19	97.68	0.0075	2.00
10.008	10.01	-169	97.29	0.0086	2.00
6.885	6.89	15	-	0.0082	2.00

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

### Calibration Report

**Certificate No.:** 2301846-001-01  
**Equipment:** Digital Thermometer with RTD  
**Resolution:** 0.1 °C  
**Model:** SevenEasy TM S20 pH  
**Serial No.:** 1231155210  
**ID No.:** UAE.WAT.010/2553  
**Manufacturer:** Mettler Toledo

Page 4 of 5

**Location:** Chemical Calibration Laboratory, National Food Institute  
**Environment Condition:** Ambient Temperature 25 °C ± 1 °C  
Relative Humidity 48 % ± 3 %

**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	1523	2118154	PSL-T 0673/65	07-Jun-23	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : - Low Temperature Bath (Micro Bath), Model: 7103, S/N: A39538,AN65 A85181.

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



## 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

## 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 5 of 5

**Calibration point:** 15.0, 25.0 and 30.0 °C  
**Calibration result:**

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : N/A S/N : N/A
- Dimension of probe : Diameter 3 mm., Length 120 mm., Sheath material : N/A

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.2	14.999	- 0.2	0.12
25.2	24.999	- 0.2	0.12
30.2	29.999	- 0.2	0.12

**Note**  
 - UUC\* : Unit Under Calibration

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



## Certificate of Calibration

**Equipment:** CONDUCTIVITY METER Certificate No.: C24230059  
 Model: Lab 955 Issued Date: 16 March 2023  
 Serial No. (or ID.): 16300356 Job No.: KSPR2304472  
 Manufacturer: SI Analytics Page: 1 of 2  
 Electrode Serial No. 16070067 Model : LF413T Brand : SI Analytics  
 Condition: In Condition

**Customer:** United Analyst and Engineering Consultant Company Limited  
 3 Soi Udomsuk 41 Sukhumvit Road,  
 Bangkok, Prakanong, Bangkok 10260 Thailand

**Environment Condition:** Temperature 23 °C ± 2 °C  
 Humidity 50 %RH ± 15 %RH

**Calibration Place:** Environment Laboratory, DKSH Technology Limited,  
 2533 Sukhumvit Road, Bangkok,  
 Phrakhanong, Bangkok 10260 Thailand

**Calibration By:** Mr. Atachai Ngamchanat  
**Calibration Date:** 16 March 2023  
**The Method used:** In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14  
**Traceability:** This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 838312, 838313, 838316

(Mr. Atachai Ngamchanat)  
 Person in charge

(Mr. Nitnun Srihawan)  
 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.

DKSH Technology Limited  
 2533 หมู่ 36 ถนนสุขุมวิท กรุงเทพมหานคร 10260  
 2533 Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260  
 Phone: +66 2636 7000 Email: info.calibration@dksh.com Website: www.dksh.com/ientro-thailand

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CAL-FM-C24-09. 12 Sep 2022



Certificate No.: C24230059 Page: 2 of 2

**Calibration Results:**

**Before Adjustment**

Standard	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	24.5 µS/cm	0.500 µS/cm	2.00	0.21 µS/cm
1413.0 µS/cm	1403 µS/cm	10.0 µS/cm	2.00	9.0 µS/cm
111.3 mS/cm	108.5 mS/cm	2.80 mS/cm	2.00	0.67 mS/cm

**After Adjustment ; at 1413 µS/cm**

Standard	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
25.000 µS/cm	24.8 µS/cm	0.200 µS/cm	2.00	0.21 µS/cm
1413.0 µS/cm	1413 µS/cm	0.0 µS/cm	2.00	9.0 µS/cm
111.3 mS/cm	108.8 mS/cm	2.50 mS/cm	2.00	0.67 mS/cm

The End of Certificate

DKSH Technology Limited  
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CAL-FM-C24-09. 12 Sep 2022



### ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER รุ่น: Lab 955 หมายเลขเครื่อง: 16300356

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
16 Mar 2023			16 Mar 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
<b>General</b>					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>Spectrophotometer</b>					
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แสงอัลตราไวโอเล็ต (UV < 3,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แสงที่มองเห็น (Visible < 5,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input type="checkbox"/>	<input type="checkbox"/>	
<b>pH Meter and Conductivity Meter</b>					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันเปื้อน Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. รางจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Turbidimeter</b>					
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นาน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Automatic titrator</b>					
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ : Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ 25.0 ±0.1°C

Mr. Atachai Ngamchanat

Service Engineer

เอกสารไม่ควบคุม

DKSH Services Co., Ltd.  
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CAL-FM-R31-03: 20 Jul 2022

DQE Services Co., Ltd.



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### CERTIFICATE OF CALIBRATION

Certificate No.: SP23-007

Page 1 of 5

Customer: United Analyst and Engineering Consultant Co., Ltd. (Head Office)

Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration: Laboratory 315

Equipment: UV-Vis Spectrophotometer

Manufacturer: Hitachi

Model: U-1900

Serial No.: 2021-064

ID No.: UAE.WAS.006/2552

Received Date: 6 January 2023

Calibration Date: 6 January 2023

Issue Date: 10 January 2023

Condition Instrument: Used

Calibrated by:

(Mr. Tanawat Kittichuan)

Technical Manager

Approved by:

(Ms. Chomnicha Sangerng)

Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit 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 DQE Services Co., Ltd.

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FM-708-02 R01 1/11/2021

### REPORT OF CALIBRATION

Certificate No.: SP23-007

Page 2 of 5

Environment Condition: Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method: In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials:

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance Standard set	25757	95929	22 October 2023
Wavelength Standard set	25806	95916	22 October 2023
Wavelength Standard set	25758	95915	22 October 2023

Traceability: This certification is traceable to the International System of Unit maintained at National

Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC: 4.0 nm.

Scan Speed of UUC: 200 nm/min

Scan Interval of UUC: 0.1 nm.

Resolution of UUC: Photometric 0.001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co., Ltd.



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### REPORT OF CALIBRATION

Certificate No.: SP23-007

Page 3 of 5

Calibration Results: Without adjustment

Photometric Accuracy:

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	0.575	0.0037	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.181	0.0090	0.0080	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.115	0.0079	0.0081	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.961	0.0024	0.0029	2.00
	1.9763	1.968	0.0083	0.0070	2.00
546.1	0.0000	0.0000	0.0000	0.0028	2.00
	0.5191	0.518	0.0011	0.0031	2.00
	1.0003	1.000	0.0003	0.0033	2.00
	1.9987	1.993	0.0057	0.0084	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5523	0.552	0.0003	0.0030	2.00
	1.0809	1.082	-0.0011	0.0030	2.00
	2.0391	2.031	0.0081	0.0080	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5601	0.562	-0.0019	0.0032	2.00
	1.0512	1.052	-0.0008	0.0030	2.00
	1.9294	1.923	0.0064	0.0073	2.00

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FM-708-02 R01 1/11/2021

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**DQE Services**

**REPORT OF CALIBRATION**

Certificate No. : SP23-007 Page 4 of 5

**Photometric Accuracy :**

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7478	0.743	0.0048	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8686	0.861	0.0076	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2912	0.291	0.0002	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6448	0.639	0.0058	0.0055	2.00

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FM-708-02 R01 1/1/2021

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**REPORT OF CALIBRATION**

Certificate No. : SP23-007 Page 5 of 5

**Wavelength Accuracy :**

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.54	240.8	0.74	0.18	2.00
279.40	278.5	0.90	0.18	2.00
288.70	288.0	0.70	0.18	2.00
334.22	333.5	0.72	0.18	2.00
361.26	360.5	0.76	0.18	2.00
418.48	417.8	0.68	0.21	2.00
446.70	445.9	0.80	0.18	2.00
453.20	452.5	0.70	0.18	2.00
460.06	459.5	0.56	0.18	2.00
536.90	536.0	0.90	0.18	2.00
637.94	637.1	0.84	0.18	2.00
440.74	440.0	0.74	0.18	2.00
472.22	471.5	0.72	0.18	2.00
513.70	513.0	0.70	0.18	2.00
528.72	528.0	0.72	0.18	2.00
574.60	574.0	0.60	0.18	2.00
585.48	584.6	0.88	0.20	2.00
684.63	684.0	0.63	0.18	2.00
740.27	740.0	0.27	0.20	2.00
748.28	747.5	0.78	0.18	2.00
807.16	806.5	0.66	0.18	2.00
879.70	879.0	0.70	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%

- \* Indicates non TISI accredited

- End of Certificate -

เอกสารไม่ควบคุม

FM-708-02 R01 1/1/2021

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**DQE Services**

**CERTIFICATE OF CALIBRATION**

Certificate No. : SP23-008 Page 1 of 5

**Customer :** United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

**Location of calibration :** Laboratory 213

**Equipment :** UV-Vis Spectrophotometer

**Manufacturer :** Hitachi

**Model :** U-2900

**Serial No. :** 21E22-009

**ID No. :** UAE.WAT.051/2564

**Received Date :** 6 January 2023

**Calibration Date :** 6 January 2023

**Issue Date :** 10 January 2023

**Condition Instrument :** Used

**Calibrated by :** [Redacted] **Approved by :** [Redacted]

Technical Manager Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit 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 DQE Services Co., Ltd.

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FM-708-02 R01 1/1/2021

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**REPORT OF CALIBRATION**

Certificate No. : SP23-008 Page 2 of 5

**Environment Condition :** Ambient Temperature 25 ± 5 °C  
 Relative humidity 55 ± 20 %RH

**Calibration method :** In-house method CP-01 Based on ASTM E275-08

**Certified Reference Materials :**

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	95935	22 October 2023
Absorbance Standard set	25757	95929	22 October 2023
Wavelength Standard set	25806	95916	22 October 2023
Wavelength Standard set	25758	95915	22 October 2023

**Traceability :** This certification is traceable to the International System of Unit maintained at National Institute of Standards and Technology (NIST) through Starna Scientific Limited

**Spectral Band Width of UUC :** 1.5 nm.

**Scan Speed of UUC :** 200 nm/min

**Scan Interval of UUC :** 0.1 nm.

**Resolution of UUC :** Photometric 0.001 Abs.  
 Wavelength 0.1 nm.

เอกสารไม่ควบคุม

FM-708-02 R01 1/1/2021

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**DQE Services**

**REPORT OF CALIBRATION**

Certificate No. : SP23-008 Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	0.574	0.0047	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.182	0.0080	0.0080	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.114	0.0089	0.0079	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.960	0.0034	0.0029	2.00
	1.9763	1.969	0.0073	0.0070	2.00
546.1	0.0000	0.0000	0.0000	0.0028	2.00
	0.5191	0.516	0.0031	0.0031	2.00
	1.0003	0.997	0.0033	0.0033	2.00
	1.9987	1.991	0.0077	0.0084	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5523	0.550	0.0023	0.0030	2.00
	1.0809	1.078	0.0029	0.0030	2.00
	2.0391	2.032	0.0071	0.0080	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5601	0.558	0.0021	0.0031	2.00
	1.0512	1.049	0.0022	0.0030	2.00
	1.9294	1.922	0.0074	0.0073	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

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**DQE Services**

**REPORT OF CALIBRATION**

Certificate No. : SP23-008 Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.0000	0.0000	0.0050	2.00
	0.7478	0.744	0.0038	0.0057	2.00
257	0.0000	0.0000	0.0000	0.0050	2.00
	0.8686	0.863	0.0056	0.0059	2.00
313	0.0000	0.0000	0.0000	0.0050	2.00
	0.2912	0.290	0.0012	0.0051	2.00
350	0.0000	0.0000	0.0000	0.0050	2.00
	0.6448	0.639	0.0058	0.0055	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.  
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Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

**DQE Services**

**REPORT OF CALIBRATION**

Certificate No. : SP23-008 Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	241.0	0.72	0.18	2.00
279.45	278.8	0.65	0.18	2.00
287.81	287.9	-0.09	0.18	2.00
334.06	333.5	0.56	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.8	0.14	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.5	0.52	0.18	2.00
536.59	536.5	0.09	0.18	2.00
637.98	638.0	-0.02	0.18	2.00
431.38	430.6	0.78	0.18	2.00
472.50	472.0	0.50	0.18	2.00
513.47	513.0	0.47	0.18	2.00
528.88	528.5	0.38	0.18	2.00
573.17	573.7	-0.53	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.0	0.40	0.18	2.00
740.72	740.5	0.22	0.20	2.00
748.55	748.5	0.05	0.18	2.00
807.03	807.0	0.03	0.18	2.00
879.28	879.5	-0.22	0.18	2.00

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FM-708-02 R01 1/11/2021

Request No. 25-65 / 0398 MTC. ACL.No. 486 / 65

**CALIBRATION CERTIFICATE**

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies" Model AA240FS, Serial No. MY13160001  
2. Working standard solution "Inorganic Ventures" Multi Analyte Custom Grade Solution, Lot No. P2-MEB675610

SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.  
3 Soi Udornsu441, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer (WI-500-02-30)  
2. Estimation Uncertainty of Measurement in Analytical Chemistry (QP-513)

REFERENCE MATERIAL : Traceable to NIST "Agilent Technologies", "Carlo Erba"  
Cadmium Lot No. 0108047046, Chromium Lot No. 0106315418, Copper Lot No. 0107480530, Iron Lot No. 0104697566, Lead Lot No. 0104659473, Manganese Lot No. T109228A, Nickel Lot No. 0104978044, Zinc Lot No. 0100792297

CALIBRATION RANGE : 0.02,0.10,0.30,0.50,0.70 mg/l at 228.8 nm.Cd, 0.10,0.20,0.30,0.50,0.70 mg/l at 357.9 nm.Cr, 0.05,0.10,0.30,0.50,0.70 mg/l at 324.7 nm.Cu, 0.10,0.30,0.50,0.70,1.00 mg/l at 248.3 nm.Fe, 0.20,0.50,0.70,1.00,1.50 mg/l at 217.0 nm.Pb, 0.05,0.10,0.30,0.50,0.70 mg/l at 279.5 nm.Mn, 0.10,0.30,0.50,0.70,1.00 mg/l at 232.0 nm.Ni, 0.05,0.10,0.30,0.50,0.70 mg/l at 213.9 nm.Zn

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 60 %

The Atomic Absorption Spectrophotometer set has been calibrated against Reference Material traceable to National Institute of Standards and Technology ( NIST ) by The Analytical Chemistry Laboratory. The results are attached herewith.

Calibrated ( Mr. Danai Srithongkum ) Approved by ( Mrs. Thippaya Junee Fortune )  
Director of Analytical Chemistry Laboratory  
Ref. 2025265020400522001  
Calibration Date : 3 February 2022

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E-mail : rump@tistr.or.th Website:www.tistr.or.th

Office/Laboratory Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Saraburi 10280, Thailand  
Tel. (66) 0 2325 1672-80 ext. 115, 116  
Fax. (66) 0 2325 9165  
E-mail : rmtc@tistr.or.th

Office 196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand  
Tel. (66) 0 2379 6292  
Fax. (66) 0 2379 6292  
E-mail : sumai@tistr.or.th

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Request No. 25-65 / 0398

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MTC. ACL. No. 486 / 65

CALIBRATION DATA

1. Noise Level in term of standard deviation

Table with 10 columns (Element, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn) and 30 rows of noise level data for Absorbance.

Continue 2 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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

Office: 196 Phahonyothin Road, Chauchak, Bangkok 10900, Thailand. Tel: (66) 0 2577 9000. Fax: (66) 0 2577 9009. E-mail: sunsilee@tistr.or.th

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Request No. 25-65 / 0398

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MTC. ACL. No. 486 / 65

2. Precision

Table with 10 columns (Element, Conc. (mg/l), Absorbance, Ave. Abs., SD, %RSD) and 30 rows of precision data for various elements.

Continue 3 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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Request No. 25-65 / 0398

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MTC. ACL. No. 486 / 65

3. Trueness

3.1 Reading on wavelength- Cadmium(Cd) at 228.8 nm.

Table with 6 columns (Element, Standard Value of RM, Reading, Error of Measurement, Error of Measurement, Uncertainty) and 4 rows of data for Cd.

3.2 Reading on wavelength- Chromium (Cr) at 357.9 nm.

Table with 6 columns (Element, Standard Value of RM, Reading, Error of Measurement, Error of Measurement, Uncertainty) and 4 rows of data for Cr.

3.3 Reading on wavelength- Copper (Cu) at 324.7 nm.

Table with 6 columns (Element, Standard Value of RM, Reading, Error of Measurement, Error of Measurement, Uncertainty) and 4 rows of data for Cu.

Continue 4 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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Request No. 25-65 / 0398

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MTC. ACL. No. 486 / 65

3.4 Reading on wavelength- Iron (Fe) at 248.3 nm.

Table with 6 columns (Element, Standard Value of RM, Reading, Error of Measurement, Error of Measurement, Uncertainty) and 4 rows of data for Fe.

3.5 Reading on wavelength- Lead (Pb) at 217.0 nm.

Table with 6 columns (Element, Standard Value of RM, Reading, Error of Measurement, Error of Measurement, Uncertainty) and 4 rows of data for Pb.

3.6 Reading on wavelength- Manganese (Mn) at 279.5 nm.

Table with 6 columns (Element, Standard Value of RM, Reading, Error of Measurement, Error of Measurement, Uncertainty) and 4 rows of data for Mn.

Continue 5 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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Request No. 25-65 / 0398

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MTC. ACL. No. 486 / 65

3.7 Reading on wavelength- Nickel (Ni) at 232.0 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Ni	0.099	0.102	0.003	3.03	± 0.007
	0.495	0.489	-0.006	1.21	± 0.010
	0.990	0.975	-0.015	1.52	± 0.020

3.8 Reading on wavelength- Zinc (Zn) at 213.9 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Zn	0.050	0.050	0.000	0.00	± 0.012
	0.300	0.307	0.007	2.33	± 0.011
	0.700	0.660	-0.040	5.71	± 0.015

Remark : The reported uncertainty is an expanded uncertainty calculated using a coverage factor of 2 (k = 2) which gives a level of confidence of approximately 95%

Calibrated

Approved by

Shippaya Junvee Fortune)

Director of Analytical Chemistry Laboratory

Calibration date : 3 February 2022

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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บริษัท อินทิเกรทเต็ด รีเสิร์ช เซ็นเตอร์ จำกัด

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## 1. Ambient Noise

Station	Sound Level Meter		อุปกรณ์สอบเทียบ Sound Calibrator				Cal. Date
	Manufacturer by /Model	Serial No.	Manufacturer by /Model	Serial No.	Ref.	Reading Value	
1 วัดโป่งไผ่	ACO /6236 No.15	212015	ACO /2127	100012	93.92	93.9	1-Jun-23
2 บ้านโคกส้มเสี้ยว	Rion NL-42 No.10	00646442	Rion NC-74	35046798	93.98	93.9	1-Jun-23

2. Workplace Noise

Station	Sound Level Meter		อุปกรณ์สอบเทียบ Sound Calibrator				Cal. Date
	Manufacturer by /Model	Serial No.	Manufacturer by /Model	Serial No.	Ref.	Reading Value	
NPP5AB1							
1. Air Compressor							
- เครื่องที่ 1	ACO /6236 No.16	212016	ACO /2127	100012	93.92	93.8	11-Mar-23
- เครื่องที่ 2	ACO /6236 No.15	212015	ACO /2127	100012	93.92	93.9	19-Jun-23
2. Turbine							
- เครื่องที่ 1	ACO /6236 No.15	212015	ACO /2127	100012	93.92	93.9	11-Mar-23
- เครื่องที่ 2	ACO /6236 No.11	192014	ACO /2127	100012	93.92	93.9	19-Jun-23

3. Ambient Air (Jan-Jun 2023)

Station	Duration	SO2		NO2		อุปกรณ์สอบเทียบ		Calibrator Gas Cylinder
		Manufacturer by/Model	Serial No.	Manufacturer by /Model	Serial No.	Manufacturer by /Model	Serial No.	
A . IRC Mobile AQMS #1		Teledyne API	188	Teledyne API	186	Teledyne API	181	Cylinder I.D. : LL193324
NPP5		/ T100		/T200		/T700		Concentration :Sulfur Dioxide = 50.54 ppm
1. วัดโป่งไผ่	30 Jan - 6 Feb							Concentration : Nitric Oxide = 50.67 ppm
								Certification Date : 05 September 2018
								Expiration Date : 05 September 2026
B. IRC Mobile AQMS #2		Teledyne API	694	Teledyne API	816	Teledyne API	348	Cylinder I.D. : LL193324
NPP5		/ T100		/T200		/T700		Concentration :Sulfur Dioxide = 50.54 ppm
1. บ้านโคกส้มเสี้ยว	30 Jan - 6 Feb							Concentration : Nitric Oxide = 50.67 ppm
								Certification Date : 05 September 2018
								Expiration Date : 05 September 2026

IRC Calibration Record 2561-2566

No.	Manufacturer by /Model	Serial No.	Calibration Result					Tolerance Limit	Calibrated by
			2562	2563	2564	2565	2566		
<b>A: Sound Calibrator</b>									
1	ACO /2127	100012	93.95 dB	93.90 dB	93.92 dB	93.92 dB	93.92 dB	± 0.4 dB	TISTR
2	Delta Ohm /HD9102	10038483	-	113.96 dB	113.92 dB	113.92 dB	113.96 dB	± 0.75 dB	TISTR
3	Rion NC-74	35046798	-	93.99 dB	93.94 dB	93.94 dB	93.98 dB	± 0.4 dB	TISTR
<b>B: Flow Calibrator</b>									
1	Bios /Defender 510	120879	0.41-1.58 %	1.21-2.38 %	0.85-1.10 %	0.85-1.10 %	0.85-1.10 %	± 5%	TISTR
<b>C: Balance</b>									
1	Micro Balance								
	Satorius ME36S	27206085	± 0.08 mg	± 0.08 mg	± 0.08 mg	± 0.08 mg	± 0.08 mg	± 0.2 mg	SPCRT
2	Analytical Balance								
	Satorius / BSA224S-CW	31591470	-	± 0.3 mg	± 0.3 mg	± 0.3 mg	± 0.3 mg	± 5 mg	SPCRT



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219 MTC No. EEL. BP. 135/0166

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.
Address : 122 Moo 2 T.Thatoom A.Srimahaphote Prachinburi 25140.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator Temperature : (23 ± 3) °C
Manufacturer : ACO Relative Humidity : (50 ± 15) %
Model : 2127 Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 100012

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

Calibration Procedure: CP-102-04 based on IEC 60942:2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 13 Jan. 2023
Date of Calibration : 18 Jan. 2023

The results relate only to the items tested/calibrated or value assigned.
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Office/Laboratory Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
Office 196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219 MTC No. EEL. BP. 135/0166

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

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

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

1. Sound Pressure Level

Table with 5 columns: Standard Microphone Type, Measured Sound Pressure Level (dB), Deviated value (dB), Uncertainty (dB), Tolerance limit. Row 1: 1/2 inch Bruel&Kjaer 4180, 93.92, -0.08, ± 0.10, ±0.40 dB

2. Frequency

Table with 5 columns: Standard Microphone Type, Measured Frequency (Hz), Deviated value (Hz), Uncertainty (Hz), Tolerance limit. Row 1: 1/2 inch Bruel&Kjaer 4180, 999.9, -0.1, ± 1.5, ±1.0%

3. Total distortion

Table with 4 columns: Standard Microphone Type, Measured Total distortion (%), Uncertainty (%), Tolerance limit. Row 1: 1/2 inch Bruel&Kjaer 4180, 2.15, ± 0.50, ±3.0%

- Note : 1. No adjustment.
2. The calibrator pressure correction was not included.
3. The microphone volume correction was not included.

Calibrated by [Redacted]

Approved by : [Redacted]

Director Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 18 Jan. 2023
Date of Issue : 19 Jan. 2023

End of Certificate 2 / 2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219 MTC No. EEL. BP. 136/0166

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.
Address : 122 Moo 2 T.Thatoom A.Srimahaphote Prachinburi 25140.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator Temperature : (23 ± 3) °C
Manufacturer : Rion Relative Humidity : (50 ± 15) %
Model : NC-74 Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 35046798

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

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

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

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

Date of Receipt : 13 Jan. 2023
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Office 196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219 MTC No. EEL. BP. 136/0166

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

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

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

1. Sound Pressure Level

Table with 5 columns: Standard Microphone Type, Measured Sound Pressure Level (dB), Deviated value (dB), Uncertainty (dB), Tolerance limit. Row 1: 1/2 inch Bruel&Kjaer 4180, 93.98, -0.02, ± 0.10, ±0.40 dB

2. Frequency

Table with 5 columns: Standard Microphone Type, Measured Frequency (Hz), Deviated value (Hz), Uncertainty (Hz), Tolerance limit. Row 1: 1/2 inch Bruel&Kjaer 4180, 1001.5, 1.5, ± 1.5, ±1.0%

3. Total Distortion

Table with 4 columns: Standard Microphone Type, Measured Total Distortion (%), Uncertainty (%), Tolerance limit. Row 1: 1/2 inch Bruel&Kjaer 4180, 1.00, ± 0.50, ±3.0%

- Note : 1. No adjustment.
2. The calibrator pressure correction was not included.
3. The microphone volume correction was included at level of 0.16 dB from nominal.

Calibrated by : [Redacted]

Approved by : [Redacted]

Director Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 18 Jan. 2023
Date of Issue : 19 Jan. 2023

End of Certificate 2 / 2

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Office 196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

### CALIBRATION CERTIFICATE

**Submitted by** : Integrated Research Center Company Limited.  
**Address** : 122 Moo 2 T.Thatoom, A.Srimahaphote, Prachinburi 25140  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
 Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

**Instrument Calibrated :**

<b>Description</b> : Sound Level Meter	<b>Ambient Environment</b>
<b>Manufacturer</b> : ACO	<b>Temperature</b> : (23 ± 3) °C
<b>Model</b> : 6236	<b>Relative Humidity</b> : (50 ± 15) %
<b>Serial No.</b> : 192014	<b>Ambient Pressure</b> : (101.325±1.5) kPa
<b>Microphone</b> : 7052NR No.73303	
<b>Preamplifier</b> : -	

- Standards used :**
1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
  2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
  3. Decade Attenuator Ando AL-205 S/N 00464602.
  4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
  5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
  6. Digital Multimeter Fluke 8520A S/N 4985007.
  7. Pistonphone Rion NC-72 S/N 00402446.
  8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Date of Receipt** : 13 Jan. 2023

**Date of Calibration** : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

#### Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

**Date of Calibration** : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

#### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
114.00	113.9	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.1 dB.

#### 2. Self-generated noise

##### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.1	0.10	N/A
C-Weight	18.0	0.10	N/A
Flat	21.9	0.10	N/A

**Date of Calibration** : 13 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

#### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.1	0.0	1.5	0.45	0.6
1 000	-0.6	-0.6	-0.5	1.0	0.45	0.6
8 000	-2.3	-2.5	-2.1	5.0	0.45	0.7

#### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	-0.1	2.0	0.20	0.6
125	0.0	0.0	-0.1	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	0.20	0.6	0.6
2 000	-0.1	0.0	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

**Date of Calibration** : 13 Feb. 2023

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 13 Feb. 2023

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3

Date of Calibration : 13 Feb. 2023

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
34	34.0	0.0	1.1	0.30	0.3
33	33.0	0.0	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.1	0.1	1.1	0.30	0.3
30	30.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.3	0.3	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.2	0.2	1.1	0.30	0.3
20-80	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 13 Feb. 2023

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**10. Peak C sound level**

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

**11. Overload indication**

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

**12. High-level stability**

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by:

Approved by:



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 13 Feb. 2023

Date of Issue : 13 Feb. 2023

Ref: 2011266011300149010

End of Certificate

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**CALIBRATION CERTIFICATE**

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2 T.Thatoom, A.Srimalaphote, Prachinburi 25140

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 212015

Microphone : 7052NR No.76236

Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325±1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 13 Jan. 2023

Date of Calibration : 9 Feb. 2023

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

**Calibration Procedure :**

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 9 Feb. 2023

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**1. Absolute Sensitivity**

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
114.02	114.4	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.8 dB.

**2. Self-generated noise**

**2.1 Normal test**

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.2	0.10	N/A
C-Weight	18.6	0.10	N/A
Flat	23.7	0.10	N/A

Date of Calibration : 9 Feb. 2023

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.4	0.3	0.3	1.5	0.45	0.6
1 000	-0.8	-0.8	-0.8	1.0	0.45	0.6
8 000	-1.2	-1.2	-0.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	0.0	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	0.0	2.0	0.20	0.6
4 000	-0.4	-0.4	0.0	3.0	0.20	0.6
8 000	-0.6	-0.7	-0.2	5.0	0.20	0.7

Date of Calibration : 9 Feb. 2023

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.2	0.2	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	93.9	-0.1	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	93.9	-0.1	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

Date of Calibration : 9 Feb. 2023

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.4	0.4	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.1	0.1	1.1	0.30	0.3
20-80	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.9	-0.1	±1.0	0.20	0.3
	2	98.6	-0.4	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by : [Redacted]  
(Mr. Wittawat Supanich)

Approved by : [Redacted]  
Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 9 Feb. 2023

Date of Issue : 10 Feb. 2023

Ref : 2011266011300149004

End of Certificate

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2 T.Thatoom, A.Srimahaphote, Prachinburi 25140

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

<b>Instrument Calibrated :</b>	<b>Ambient Environment</b>
Description : Sound Level Meter	Temperature : (23 ± 3) °C
Manufacturer : ACO	Relative Humidity : (50 ± 15) %
Model : 6236	Ambient Pressure : (101.325 ± 1.5) kPa
Serial No. : 212016	
Microphone : 7052NR No.76237	
Preamplifier : -	

Standards used :

- Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Digital Multimeter Fluke 8520A S/N 4985007.
- Pistonphone Rion NC-72 S/N 00402446.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 13 Jan. 2023

Date of Calibration : 10 Feb. 2023

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- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tannoy Limited, Great Britain British Patent No. 215300.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 10 Feb. 2023

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
114.00	114.5	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.1	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.9	0.10	N/A
C-Weight	18.7	0.10	N/A
Flat	23.6	0.10	N/A

Date of Calibration : 10 Feb. 2023

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.0	-0.1	1.5	0.45	0.6
1 000	-0.9	-0.9	-0.7	1.0	0.45	0.6
8 000	0.4	0.4	0.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	0.0	2.0	0.20	0.6
125	0.1	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	-0.1	0.0	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	103.9	-0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

Date of Calibration : 10 Feb. 2023

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
34	34.0	0.0	1.1	0.30	0.3
33	33.0	0.0	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.1	0.1	1.1	0.30	0.3
30	30.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	93.9	-0.1	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	93.9	-0.1	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

Date of Calibration : 10 Feb. 2023

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.1	0.1	1.1	0.30	0.3
20-100	25	25.2	0.2	1.1	0.30	0.3
20-90	25	25.2	0.2	1.1	0.30	0.3
20-80	25	25.1	0.1	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T <sub>b</sub> (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.8	-0.2	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	110.0	0.0	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by [Redacted]

Approved by : [Redacted]

Director  
Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 10 Feb. 2023

Date of Issue : 10 Feb. 2023

Ref: 2011266011300149005

End of Certificate

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2 T.Thathom, A.Simhaphote, Prachinburi 25140

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

Instrument Calibrated :

Ambient Environment

Description : Sound Level Meter

Temperature : (23 ± 3) °C

Manufacturer : Rion

Relative Humidity : (50 ± 15) %

Model : NL-42

Ambient Pressure : (101.325±1.5) kPa

Serial No. : 00646442

Microphone : UC-52 No.153069

Preamplifier : NH-24 No.46656

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 13 Jan. 2023

Date of Calibration : 9 Feb. 2023

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tanny Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

**Calibration Procedure :**

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 9 Feb. 2023

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**1. Absolute Sensitivity**

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.97	118.0	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.3 dB.

**2. Self-generated noise**

**2.1 Normal test**

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
16.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.6	0.10	N/A
C-Weight	18.8	0.10	N/A
Flat	24.1	0.10	N/A

Date of Calibration : 9 Feb. 2023

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**3. Acoustical signal test of frequency weightings**

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.0	0.1	0.1	1.5	0.45	0.6
1 000	0.0	0.0	0.0	1.0	0.45	0.6
8 000	-1.7	-1.7	-1.8	5.0	0.45	0.7

**4. Electrical signal test of frequency weightings**

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.1	0.1	2.0	0.20	0.6
125	0.0	0.1	0.1	1.5	0.20	0.6
250	0.0	0.1	0.1	1.5	0.20	0.6
500	0.0	0.1	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.2	-0.1	-0.1	2.0	0.20	0.6
4 000	-0.3	-0.3	-0.3	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

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**5. Long-term stability**

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

**6. Frequency and time weightings at 1 kHz**

**6.1 Frequency weightings at 1 kHz**

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

**6.2 Time weightings at 1 kHz**

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
128	127.9	-0.1	1.1	0.30	0.3
127	127.0	0.0	1.1	0.30	0.3
126	125.9	-0.1	1.1	0.30	0.3
125	124.9	-0.1	1.1	0.30	0.3
124	123.9	-0.1	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
44	43.9	-0.1	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
24	23.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
80-130	94.0	94.0	0.0	1.1	0.30	0.3
70-120	94.0	94.0	0.0	1.1	0.30	0.3
60-110	94.0	94.0	0.0	1.1	0.30	0.3
50-100	94.0	94.0	0.0	1.1	0.30	0.3

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Fax. (66) 0 2579 8592  
E-mail : sumaleeg@tistr.or.th

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
80-130	85	85.0	0.0	1.1	0.30	0.3
70-120	75	75.0	0.0	1.1	0.30	0.3
60-110	65	65.0	0.0	1.1	0.30	0.3
50-100	55	54.9	-0.1	1.1	0.30	0.3
40-90	45	44.9	-0.1	1.1	0.30	0.3
30-80	35	35.0	0.0	1.1	0.30	0.3
20-70	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	99.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	89.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -5.0	0.20	0.3
SEL	200	110.0	0.0	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 9 Feb. 2023

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Fax. (66) 0 2577 9009  
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory  
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Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
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E-mail : sumaleeg@tistr.or.th

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	1.5	0.20	0.25
136.5	136.5				

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0		0.3	0.10	0.1
End	129.0	0.0			

Calibrated by

Approved by :

Date of Calibration : 9 Feb. 2023

Date of Issue : 9 Feb. 2023

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266011300149009

End of Certificate

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Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand  
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Fax. (66) 0 2579 8592  
E-mail : sumaleeg@tistr.or.th



### Certificate of Calibration

Certificate Number : **MBI-1843-2022** Page 1 of 2 Pages

**Equipment :** Electronic Balance  
**Manufacturer :** Sartorius  
**Model :** BSA2245-CW  
**Serial Number :** 31591470  
**ID Number :** N/A  
**Max Capacity :** 220 ( g )  
**Resolution :** 0.0001 ( g )

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor *k*, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS M3003 requirements. This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI). This Certificate may not be reproduced other than in full except with the prior written approval of Calibration Center, Intro TSC Co., Ltd.

**Customer Reference :** L087 **Customer :** INTEGRATED RESEARCH CENTER CO.,LTD.  
**CSRS No.:** CSRS19851022 122 Moo 2, T. Thatoom,  
**Date of Receipt :** 28-Oct-22 A. Srimahaphote, Prachinburi 25140  
**Date of Calibration :** 31-Oct-22 **Location :** WATER LAP IP-1

**Condition of this result of calibration**

1. Reference Standard instruments :

Instruments	Model	Serial No.	Certificate No.	Due Date
Weight set (1 mg to 200 g)	Class E2	K-1871/20	10468/3149/20	22-Nov-22

2. This Certification is traceable to the International System of Unit maintained at : -

- National Institute of Metrology (Thailand)


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

**Method :** Measurement In-house Method Calibration Procedure No. CP-CL-43 base on UKAS Publication Ref: Lab 14 : 2019

**Environmental Conditions :**

**Temperature :** ( 30 ± 10 ) °C **Humidity :** ( 50 ± 20 ) % **Air Pressure :** ( 1010 ± 10 ) mbar

**Calibrated By :** Mr. Lek Intasen  
**Date of Issued :** 3-Nov-22

**Approved Signatory :**   
 Ms. Natthasartorn Intasen

FM-CL-11-05



Certificate Number : **MBI-1843-2022** Page 2 of 2 Pages

Calibration Result ( Weight ) : Without Adjustment

**1. Repeatability of Reading**

Nominal Value ( g )	Standard Deviation ( g )	Maximum diff. Between successive ( g )
200	0.00000	0.0000

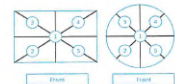
**2. Error of indication from nominal value**

Nominal Value ( g )	Balance Reading ( g )	Correction Value ( g )	Uncertainty ( ± ) ( g )	factor <i>k</i>	Balance Reading Before Adjust ( g )
Unload	0.0000	0.0000	0.000084	2.00	-
20	20.0000	0.0000	0.00010	2.00	-
40	40.0000	0.0000	0.00013	2.00	-
60	60.0000	0.0000	0.00021	2.00	-
80	80.0000	0.0000	0.00021	2.00	-
100	100.0000	0.0000	0.00022	2.00	-
120	120.0000	0.0000	0.00040	2.00	-
140	140.0000	0.0000	0.00040	2.00	-
160	160.0000	0.0000	0.00040	2.00	-
180	180.0000	0.0000	0.00040	2.00	-
200	200.0000	0.0000	0.00040	2.00	-

**3. Eccentric or off-center loading**

Nominal Value ( g )	Reference Position				
	Position 1 ( g )	Position 2 ( g )	Position 3 ( g )	Position 4 ( g )	Position 5 ( g )
100	100.0000	100.0000	100.0000	100.0000	100.0000

Eccentric Error = 0.0000 ( g )



End of report



### Certificate of Calibration

Certificate Number : **MBI-1844-2022** Page 1 of 2 Pages

**Equipment :** Electronic Balance  
**Manufacturer :** Sartorius  
**Model :** ME36S  
**Serial Number :** 27206085  
**ID Number :** N/A  
**Max Capacity :** 31000 ( mg )  
**Resolution :** 0.001 ( mg )

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor *k*, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS M3003 requirements. This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI). This Certificate may not be reproduced other than in full except with the prior written approval of Calibration Center, Intro TSC Co., Ltd.

**Customer Reference :** L087 **Customer :** INTEGRATED RESEARCH CENTER CO.,LTD.  
**CSRS No.:** CSRS19851022 122 Moo 2, T. Thatoom,  
**Date of Receipt :** 28-Oct-22 A. Srimahaphote, Prachinburi 25140  
**Date of Calibration :** 31-Oct-22 **Location :** WATER LAB IP-1

**Condition of this result of calibration**

1. Reference Standard instruments :

Instruments	Model	Serial No.	Certificate No.	Due Date
Weight set (1 mg to 200 g)	Class E2	K-1871/20	10468/3149/20	22-Nov-22

2. This Certification is traceable to the International System of Unit maintained at : -

- National Institute of Metrology (Thailand)

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

**Method :** Measurement In-house Method Calibration Procedure No. CP-CL-43 base on UKAS Publication Ref: Lab 14 : 2019

**Environmental Conditions :**

**Temperature :** ( 30 ± 10 ) °C **Humidity :** ( 50 ± 20 ) % **Air Pressure :** ( 1010 ± 10 ) mbar

**Calibrated By :** Mr. Lek Intasen  
**Date of Issued :** 3-Nov-22

**Approved Signatory :**   
 Ms. Natthasartorn Intasen

FM-CL-11-05



Certificate Number : **MBI-1844-2022** Page 2 of 2 Pages

Calibration Result ( Weight ) : Without Adjustment

**1. Repeatability of Reading**

Nominal Value ( mg )	Standard Deviation ( mg )	Maximum diff. Between successive ( mg )
30000	0.0008	0.002

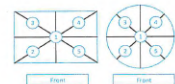
**2. Error of indication from nominal value**

Nominal Value ( mg )	Balance Reading ( mg )	Correction Value ( mg )	Uncertainty ( ± ) ( mg )	factor <i>k</i>	Balance Reading Before Adjust ( mg )
Unload	0.000	0.000	0.00084	2.00	-
3000	3000.003	-0.003	0.028	2.00	-
6000	6000.007	-0.007	0.040	2.00	-
9000	9000.016	-0.016	0.043	2.00	-
12000	11999.984	0.016	0.10	2.00	-
15000	14999.976	0.024	0.10	2.00	-
18000	17999.967	0.033	0.10	2.00	-
21000	20999.953	0.047	0.13	2.00	-
24000	23999.943	0.057	0.13	2.00	-
27000	26999.938	0.062	0.13	2.00	-
30000	29999.922	0.078	0.13	2.00	-

**3. Eccentric or off-center loading**

Nominal Value ( mg )	Reference Position				
	Position 1 ( mg )	Position 2 ( mg )	Position 3 ( mg )	Position 4 ( mg )	Position 5 ( mg )
10000	9999.997	9999.998	9999.988	9999.983	9999.988

Eccentric Error = 0.014 ( mg )



End of report



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-66/0173

MTC.No.23-66/0173

Number of page(s) 2

### CALIBRATION CERTIFICATE

**Nomenclature : DRYCAL FLOWMETER**

Manufacturer : Bios International Corporation, USA

Serial No.: 120879

Model : Defender 510 M

Scale range : 50 ml/min to 5000 ml/min

Subdivision : (0.00001, 0.0001, 0.001) l/min

**Submitted by : INTEGRATED RESEARCH CENTER COMPANY LIMITED.**

122 T.Thatoom A.Srimahaphote,

Prachinburi 25140, Thailand.

**Received date :** 13 January 2023 **Condition of measured item :** Normal

**Calibration date :** 19 January 2023

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 643/65	1-Jun-24	TISTR
Molbox/Pressure Transducer/UpStream	MP-0013-21	25-Jan-23	NIMT
Primary Flow Calibrator S/N 117982	MW-0011-21	8-Apr-23	NIMT
Primary Flow Calibrator S/N 119521	MW-0012-21	31-Mar-23	NIMT

**Calibrated by :**

(Mr.Terasak Panna)

**Approved by :**

Director  
Mechanical Engineering Standards Laboratory

Ref. 2013266011300154001

Issued Date 19 January 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-66/0173

2/2

MTC.No.23-66/0173

**Calibration point :** (0.05, 0.5, 1, 1.5, 2) l/min

**Ambient condition :** Temperature ( 23 ± 3 ) °C , Relative humidity ( 55 ± 15 ) %

Atmospheric pressure ( 1010±13 ) hPa

**Calibration method :** The flowmeter (UUC) was calibrated by comparison method with standard flowmeter according to CP-370.01.

The reported value is the value that converted to value at reference condition within pressure and temperature of the actual gas entering the UUC

**Measurement data :**

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.05655	0.055399	24.624	1006.36	+2.08	1.00
0.51386	0.50293	24.659	1006.60	+2.17	0.99
1.0232	1.0974	24.616	1006.84	-6.76	0.86
1.5371	1.5037	24.608	1007.10	+2.22	0.86
2.0531	2.0096	24.591	1007.36	+2.17	0.86

The reported expanded uncertainties are based on standard uncertainties multiplied by a coverage factor k=2, which provides a level of confidence of approximately 95%.

The end of calibration certificate.

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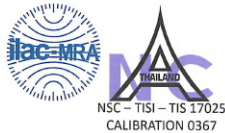


JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd  
63/14-15, 67/95-96  
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Bangkok 10500(Thailand)  
Tel: +668680812  
Mobile: +66863999453  
E-mail: nac-cal@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-17025  
CALIBRATION 0367

Flow measurement laboratory  
Calibration services department.



### CERTIFICATE OF CALIBRATION

Certificate No. : CL-008-66

Page 1 of 2 Pages

#### MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Top Load Office

TISCH

TE-5028A

2526

-

Used item

Integrated Research Center Company Limited.

122 Moo 2, Thatoom, Srimahaphote, Prachinburi 25140, Thailand.

RECEIVED DATE

20 Mar 2023

MEASUREMENT DATE

24 Apr 2023

ISSUE DATE

24 Apr 2023

#### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

Atmospheric Pressure : 1010 ± 10 hPa

#### CALIBRATION CONDITION:

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are 24.4 °C and 51.3%RH.

#### TABULATION OF RESULTS:

The table on next page give the measured values.

#### Calibration procedure:

The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/MC192-01s. The WJ-CL-004 was used as a calibration guideline.

#### Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

#### Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM Evaluation of measurement data - Guide to the expression of uncertainty in measurement



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Continuation of Certificate of Calibration Number CL-008-66

Page 2 of 2 Pages

#### MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [°F] °C	Temperature [°F] °C	Δp_meter mmHg	Δp_Orifice inH <sub>2</sub> O	γ	Standard Flow [Q <sub>s</sub> ] m <sup>3</sup> /min
1	0.705	758.329	24.44	23.77	50.462	1.122	1.059	0.659
2	1.001	758.356	24.29	23.90	36.610	2.376	1.542	0.954
3	1.117	758.415	24.01	23.47	31.484	3.004	1.734	1.074
4	1.166	758.484	23.86	23.34	29.640	3.290	1.915	1.124
5	1.418	758.544	23.98	23.51	18.777	5.030	2.245	1.387

Slope (m):

1.62707

Intercept (b):

-0.01273

Correlation coefficient (r):

0.99981

Uncertainty (k=2):

0.015 m<sup>3</sup>/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [°F] °C	Temperature [°F] °C	Δp_meter mmHg	Δp_Orifice inH <sub>2</sub> O	γ	Standard Flow [Q <sub>s</sub> ] m <sup>3</sup> /min
1	0.705	758.329	24.44	23.77	50.462	1.122	0.664	0.659
2	1.001	758.356	24.29	23.90	36.610	2.376	0.965	0.954
3	1.117	758.415	24.01	23.47	31.484	3.004	1.085	1.073
4	1.166	758.484	23.86	23.34	29.640	3.290	1.135	1.122
5	1.418	758.544	23.98	23.51	18.777	5.030	1.404	1.385

Slope (m):

1.01912

Intercept (b):

-0.00799

Correlation coefficient (r):

0.99981

Uncertainty (k=2):

0.015 m<sup>3</sup>/min

\*\*\*End of Certificate of Calibration\*\*\*



Calibrated by:  
 Mr. Sorawit Thachalad  
 Miss Jitraporn Lertsomphol

Approved signature

Mr. Farnya Booncharoen  
Calibration Department Manager

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

Part Number: E03N199E80A0020      Reference Number: 82-401285019-1  
 Cylinder Number: LL193324      Cylinder Volume: 83.4 CF  
 Laboratory: 124 - Riverton (SAP) - NJ      Cylinder Pressure: 2215 PSIG  
 PGVP Number: B52018      Valve Outlet: 660  
 Gas Code: NO,NOX,SO2,BALN      Certification Date: Sep 05, 2018

**Expiration Date: Sep 05, 2026**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.  
 Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	50.00 PPM	50.71 PPM	G1	+/- 1.4% NIST Traceable	08/27/2018, 09/05/2018
NITRIC OXIDE	50.00 PPM	50.67 PPM	G1	+/- 1.4% NIST Traceable	08/27/2018, 09/05/2018
SULFUR DIOXIDE	50.00 PPM	50.54 PPM	G1	+/- 1.0% NIST Traceable	08/27/2018, 09/05/2018
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060625	CC442585	50.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
PRM	12368	5604119	29.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	14010337	KAL004378	48.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Apr 17, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 NO	FTIR	Aug 09, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 31, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 30, 2018

**Triad Data Available Upon Request**

NOTES:PO# 5218003935

Net weight: 2736 grams  
Gross weight: 17393 grams

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-800R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05



Approved for Release