

ภาคผนวก จ

ใบรับรองการสอบเทียบเครื่องมือ

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

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
Stack									
1	Pre-Test Console	Total Suspended Particulate	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 Sulation Co., Ltd.	G 650654	28 Sep 22	27 Sep 23	-

List of Opacity Training Certification for Opacity Mesurement

No.	Name	Training Couse	Train	Date	Remark
1	Mr.Suksan Pansing	Opacity	Pollution Control Department	29-31 August 2007	-
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
Water									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA0D0081	Technology Promotion Association (Thailand-Japan)	23CH6	5 Jan 23	4 Jan 24	-
2	DO Meter	DO	Horiba	LAQUA-DO210 HE0H0003	Technology Promotion Association (Thailand-Japan)	23TW1	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 by :

(Mr. Mana Fuekhul)
Technical Manager

เอกสารไม่ควบคุม

**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	mm Hg	K1	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		Console Leak Check	PASS	

Calibration Data									
Run Time	Metering Console				Calibration Meter				
	DGM Orifice	Volume	Volume	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
Elapsed	DH	Initial	Final	(t _m)	(t _m)	(V _{wi})	(V _{wf})	(t _m)	(t _m)
(Q)	(P _m)	(V _m)	(V _m)	(t _m)	(t _m)	(V _{wi})	(V _{wf})	(t _m)	(t _m)
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°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



เอกสารไม่ควบคุม

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	mm Hg	K1	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		Console Leak Check	PASS	

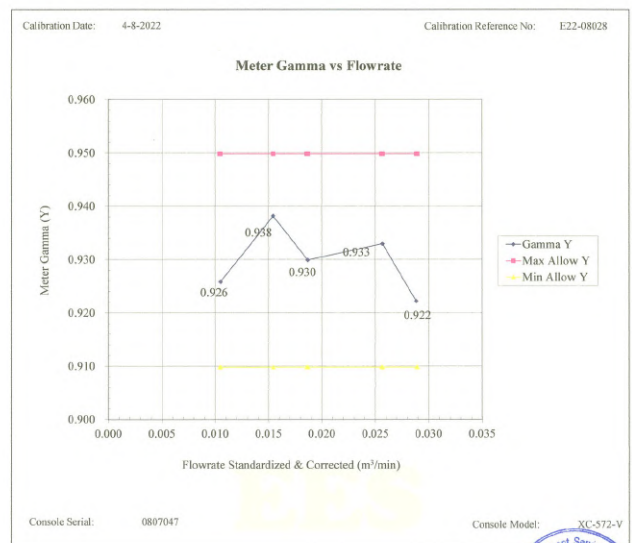
Calibration Data									
Results									
Standardized Data		Dry Gas Meter							
Dry Gas Meter (V _{m(Std)})	Calibration Meter (V _{w(Std)})	Calibration Factor		Flowrate		Std & Corr (Q _{Std(Corr)})	.0212 m ³ /min (ΔH _g)	Variation (ΔH _g)	
		Value (Y)	Variation (ΔY)	Flowrate	Variation				
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	m ³ /min	mm H ₂ O	(ΔH _g)	(ΔH _g)
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@ 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_g, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.



เอกสารไม่ควบคุม

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	mm Hg	K1	0.386	
DGM Serial Number	00003580	Calibration Meter Gamma	0.999		Console Leak Check	PASS	



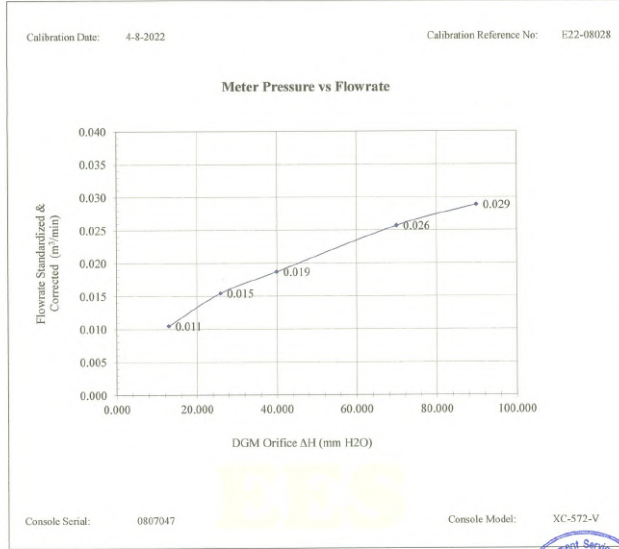
Console Serial: 0807047

Console Model: XC-572-V



เอกสารไม่ควบคุม

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 mm Hg			K1	0.386
DGM Serial Number	00003580	Calibration Meter Gamma	0.999			Console Leak Check	PASS



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-V	Date	Time	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				

Results											
Channel and test point	Console Thermocouple Simulator										
	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

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



Envl Equipment Service Co., Ltd.



เอกสารไม่ควบคุม

งานติดตามตรวจสอบคุณภาพสิ่งแวดล้อม

โครงการขยายกำลังการผลิตโรงไฟฟ้า PP 5A ครั้งที่ 1

บริษัท เนชั่นเนล เพาเวอร์ แพลนท์ 5A (สำนักงานใหญ่) 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	-

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

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
 Date of Calibration: 24 February 2023 Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C
 Calibration result:
 - The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
 - Description of probe, model: - S/N: -
 Dimension of probe: Diameter 9 mm, Length 120 mm,
 Sheath material: Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	15.015	- 0.1	0.11
25.0	25.014	0.0	0.11
35.1	35.016	- 0.1	0.11

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

Calibration Report

Certificate No.: 2302181-001-01
 Equipment: pH Meter
 Resolution: 0.01 pH : 1 mV
 Manufacturer: METTLER TOLEDO Model: SevenEasy pH
 Serial No.: 1230525212 Type: Bench top
 ID No.: UAE.WAS.003/2553
 Date of Calibration: 24 March 2023 Page 2 of 5

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

Condition of this Results of Calibration

- Calibration Method: In house method - W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)
- Reference Standards / Certified Reference Material:

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	2ZE1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH003/17	PONPE	TE 650555-01	21 September 2023

Certified Reference Material	Lot No.	Manufacturer	Ref.N	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH-216.L5	16 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH-217.L5	16 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH-220.L5	16 February 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107.L5	16 February 2024
- This certification is traceable to The International System of Unit (SI Unit)
 - Instruments No.2.1 through NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0068
 - Instruments No.2.2 through NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
 - Instruments No.2.3 through NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
 - Certified Reference Material No. 2.4 to 2.6 traceable to Primary measurement method- Hamed cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
 - Certified Reference Material No.2.7 traceable to BIM ReN HI-13 LotN 25.05.2022; BIM ReN HI-16 LotN 02.06.2022; BIM ReN HI-13 LotN 25.05.2022; BIM ReN HI-16 LotN 02.06.2022. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.

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

Calibration Certificate

Certificate No.: 2302181-001-01
 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 pH
 Serial No.: 1230525212
 ID No.: UAE.WAS.003/2553

Order No.: 2302181
 Operation No.: 2302181-001
 Date of Receipt: 14 March 2023
 Date of Calibration: 24 March 2023

Calibrated by: Mr.Pheraphat Tuanjit Scientist
 Approved by: (Mr.Nuttapol Niyomchart) Specialist, Division of Calibration Laboratory
 Responsible for the Technical Management Team

Date of Issue: 24 March 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.: 2302181-001-01
 Equipment: pH Meter
 Resolution: 0.01 pH : 1 mV
 Manufacturer: METTLER TOLEDO Model: SevenEasy pH
 Serial No.: 1230525212 Type: Bench top
 ID No.: UAE.WAS.003/2553
 Date of Calibration: 24 March 2023 Page 3 of 5

Calibration Results:

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.120	414	0.00	0.58	2.00
2	295.814	296	2.60	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.000	0	7.00	0.58	2.00
8	-59.158	-59	8.00	0.58	2.00
10	-177.460	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.117	-414	14.00	0.58	2.00

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

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

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

Certified Value (25 °C (pH))	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	187	-	0.0071	2.00
6.865	6.86	22	97.86	0.0075	2.00
10.010	10.01	-160	97.66	0.0086	2.00
6.865	6.89	14	-	0.0093	2.00

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

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: Lab 955

หมายเลขเครื่อง: 16300356

ตรวจสอบ (ปี)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
16 Mar 2023			16 Mar 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
<i>General</i>					
<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 เปิด - ปิด เครื่อง (On-Off Swich)	<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"/>	
<i>Spectrophotometer</i>					
<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. หัวหมุนเลือกความยาวคลื่น (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. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ซองวัดหลายตัวอย่าง (Carousel Module)	<input type="checkbox"/>	<input type="checkbox"/>	
<i>pH Meter and Conductivity Meter</i>					
<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. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Turbidimeter</i>					
<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 ไม่น้อยกว่า 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Automatic titrator</i>					
<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"/>	

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

Mr.Atachai Ngamchanat

Service Engineer

เอกสารไม่ควบคุม

งานติดตามตรวจสอบคุณภาพสิ่งแวดล้อม

โครงการขยายกำลังการผลิตโรงไฟฟ้า PP 5A ครั้งที่ 1

บริษัท เนชั่นเนล เพาเวอร์ แพลนท์ 5A (สำนักงานใหญ่) 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.



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 : [Redacted]
() 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.

เอกสารไม่ควบคุม



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

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

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	99.9999	+0.0001	0.19	2.03
200	200.0001	-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



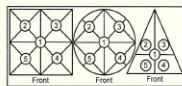
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-00150C-1

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

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	-0.0002	+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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เอกสารไม่ค



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.016/2555
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 : [Redacted]
Approved by : [Redacted]
() Pornthippa Tameyakul
(/) Malee Butkruea
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม



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)

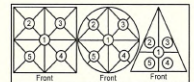
Applied Weight (g)	Standard Deviation of Reading (g)
100	0.00009
200	0.00007

เอกสารไม่คว



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

Cert.No.: 23MM332
 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)
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002

Maximum difference between off-center and central loading (g)
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

บริษัท อินทิเกรทเต็ด รีเสิร์ช เซ็นเตอร์ จำกัด

1. Ambient Noise		Sound Level Meter		อุปกรณ์สอบเทียบ Sound Calibrator				Cal. Date
Station		Manufacturer by /Model	Serial No.	Manufacturer by /Model	Serial No.	Ref.	Reading Value	
1	ริมรั้วโครงการทิศเหนือ (NPP5A) หมู่บ้านเอื้อثرพย์ (TPG)	Rion NL-42 No.8	00433730	Rion NC-74	35046798	93.98	93.7	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	
NPP5A							
1. Boiler							
- เครื่องที่ 1	ACO /6236 No.12	192015	ACO /2127	100012	93.92	93.9	9-Mar-23
- เครื่องที่ 2	Rion NL-42 No.10	00646442	Rion NC-74	35046798	93.98	93.9	19-Jun-23
2. Turbine							
- เครื่องที่ 1	ACO /6236 No.13	192016	ACO /2127	100012	93.92	93.9	9-Mar-23
- เครื่องที่ 2	ACO /6236 No.16	212016	ACO /2127	100012	93.92	93.8	19-Jun-23
3. Combustion Fan							
- เครื่องที่ 1	ACO /6236 No.11	192014	ACO /2127	100012	93.92	93.9	9-Mar-23
- เครื่องที่ 2	Rion NL-42 No.8	00433730	Rion NC-74	35046798	93.98	93.9	19-Jun-23
4. Flue Gas Recirculation							
- เครื่องที่ 1	Rion NL-42 No.9	01022362	Rion NC-74	35046798	93.94	93.9	9-Mar-23
- เครื่องที่ 2	ACO /6236 No.13	192016	ACO /2127	100012	93.92	93.9	19-Jun-23
5. Air Compressor							
- เครื่องที่ 1	Rion NL-42 No.8	00433730	Rion NC-74	35046798	93.98	93.9	9-Mar-23
- เครื่องที่ 2	ACO /6236 No.14	212014	ACO /2127	100012	93.92	93.8	19-Jun-23

3. Ambient Air (Jan-Jun 2023)

Station	Duration	SO2		NO2		อุปกรณ์สอบเทียบ Dynamic Gas Dilutor		Calibrator Gas Cylinder		
		Manufacturer by /Model	Serial No.	Manufacturer by /Model	Serial No.	Manufacturer by /Model	Serial No.			
IRC Mobile AQMS #2		Teledyne API / T100	694	Teledyne API /T200	816	Teledyne API /T700	348	Cylinder I.D. : LL193324 Concentration :Sulfur Dioxide = 50.54 ppm Concentration : Nitric Oxide = 50.67 ppm Certification Date : 05 September 2018 Expiration Date : 05 September 2026		
NPP5										
1. วัดบุนายใบ	2 - 9 June									
Mix EIA #1/2023		Teledyne API / T100	430	Teledyne API / T200	374	Dasibi Environmental Corp/5008	486	Cylinder I.D. : EB0128767 Concentration : Sulfur Dioxide = 55.62 ppm Concentration : Nitric Oxide = 57.21 ppm Certification Date : 29 October 2019 Expiration Date : 29 October 2027		
1. วัดโป่งไผ่	2 - 9 June								Teledyne API / T100	3569
2. อนามัยท่าตุม				Teledyne API / T100	1626				Thermo Fisher Scientific/42C	17C-68152-359
3. บ้านโคกส้มเสี้ยว										

IRC Calibration Record 2561-66

No.	Manufacturer by /Model	Serial No.	Calibration Result					Tolerance Limit	Calibrated by
			2562	2563	2564	2565	2566		
A: Sound Calibrator									
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: Flow Calibrator									
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
C: Balance									
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

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, Samutprakran 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. : 00433730	
Microphone : UC-52 No.144953	
Preamplifier : NH-24 No.33780	

- 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 : 7 Feb. 2023

The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governing body.

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 : 7 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	114.1	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 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
17.0	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	12.4	0.10	N/A
C-Weight	17.7	0.10	N/A
Flat	23.1	0.10	N/A

Date of Calibration : 7 Feb. 2023

The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governing body.

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	0.0	1.5	0.45	0.6
1 000	0.1	0.1	0.1	1.0	0.45	0.6
8 000	-2.5	-2.5	-2.6	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	0.1	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	-0.1	2.0	0.20	0.6
4 000	-0.3	-0.3	-0.2	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

Date of Calibration : 7 Feb. 2023

The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governing body.

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

Date of Calibration : 7 Feb. 2023

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The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the government.

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	128.1	0.1	1.1	0.30	0.3
127	127.1	0.1	1.1	0.30	0.3
126	126.1	0.1	1.1	0.30	0.3
125	125.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	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	79.1	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	64.0	0.0	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

Date of Calibration : 7 Feb. 2023

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The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the government.

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	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	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

Date of Calibration : 7 Feb. 2023

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The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the government.

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	24.9	-0.1	1.1	0.30	0.3

Date of Calibration : 7 Feb. 2023

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The results relate only to the items tested/calibrated or value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the government.

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				
136.6	136.6	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]
(Mr. Prawate Klauyap)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 7 Feb. 2023
Date of Issue : 9 Feb. 2023

Ref: 201126601300149007

End of Certificate

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

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 :

Description : Sound Calibrator

Manufacturer : Rion

Model : NC-74

Serial No. : 35046798

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

- Standards used :
- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 - Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 - Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 - Digital Multimeter Agilent 34401A S/N MY44005560.
 - Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 - Audio Analyzer Keithley 2015-P S/N 4106495.
 - 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 volume 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

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E-mail : sumalee@tistr.or.th

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

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.98	-0.02	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1001.5	1.5	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 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 manual.

Calibrated by: [Redacted]

Approved by: [Redacted]
(Mr. Prawate Klauyap)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

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

Ref: 201126601300149002

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.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00646442

Microphone : UC-52 No.153069

Preamplifier : NH-24 No.46656

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325±1.5) kPa

- Standards used :
- Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
 - Condenser Microphone Bruel&Kjaer 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 Bruel&Kjaer 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				
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

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

Date of Calibration : 9 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)
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

Date of Calibration : 9 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)
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

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)
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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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				
136.5	136.5	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]
(Mr. Prayate Klaiyapa)

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 9 Feb. 2023

Date of Issue : 9 Feb. 2023

Ref : 2011266011300149009

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.

Instrument Calibrated :

Description : Sound Level Meter	Ambient Environment
Manufacturer : Rion	Temperature : (23 ± 3) °C
Model : NL-42	Relative Humidity : (50 ± 15) %
Serial No. : 01022362	Ambient Pressure : (101.325±1.5) kPa

Microphone : UC-52 No.142301
Preamplifier : NH-24 No.22410

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

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	114.1	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 114.0 dB.

2. Self-generated noise
2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
16.5	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	24.0	0.10	N/A

Date of Calibration : 9 Feb. 2023

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 E-mail : sumalee@tistr.or.th

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	0.0	-0.1	1.5	0.45	0.6
1 000	-0.1	0.0	0.0	1.0	0.45	0.6
8 000	-3.7	-3.8	-3.8	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	0.0	0.0	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	-0.1	-0.1	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.3	-0.3	3.0	0.20	0.6
8 000	0.0	-0.1	-0.1	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)
128	128.1	0.1	1.1	0.30	0.3
127	127.1	0.1	1.1	0.30	0.3
126	126.1	0.1	1.1	0.30	0.3
125	125.1	0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.1	0.1	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.1	0.1	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.1	0.1	1.1	0.30	0.3
84	84.0	0.0	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	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	49.0	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)
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	29.0	0.0	1.1	0.30	0.3
24	24.0	0.0	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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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	55.0	0.0	1.1	0.30	0.3
40-90	45	45.0	0.0	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	98.9	-0.1	+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	90.0	0.0	+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	125.3	-0.1	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				
136.6	136.6	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]
(Mr. Pawate Klunypa)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 9 Feb. 2023
Date of Issue : 9 Feb. 2023

Ref: 2011266011300149008

End of Certificate

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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 : 13 Feb. 2023

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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.

Instrument Calibrated :

Description : Sound Level Meter
Manufacturer : ACO
Model : 6236
Serial No. : 192014
Microphone : 7052NR No.73303
Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325±1.5) kPa

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 : 13 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	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

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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	0.1	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	1.0	0.20	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

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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

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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 (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, T _b (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

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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 :

[Redacted Signature]

[Redacted Signature]

Director
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.Srimaphote, Prachinburi 25140

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

Instrument Calibrated :	Ambient Environment
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. : 192015	
Microphone : 7052NR No.73304	
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 : 13 Feb. 2023

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- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tannoy Limited, Great Britain British Patent No. 2153300.
- 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 : 13 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	112.0	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 115.8 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	15.6	0.10	N/A
C-Weight	21.2	0.10	N/A
Flat	25.6	0.10	N/A

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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	-0.1	-0.2	1.5	0.45	0.6
1 000	0.0	0.0	0.1	1.0	0.45	0.6
8 000	-2.5	-2.1	-1.7	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	-0.1	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	0.0	0.0	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.3	-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	119.1	0.1	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	79.1	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	39.1	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)
34	34.2	0.2	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.3	0.3	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.4	0.4	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	93.9	-0.1	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	25.3	0.3	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, Tb(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	98.0	-1.0	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.3	-0.3	±1.0	0.20	0.3
	2	89.7	-0.3	+1.0; -5.0	0.20	0.3
SEL	200	109.8	-0.2	±1.0	0.20	0.3
	2	89.9	-0.1	+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	124.3	-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 : 
(Mr. Wittawat Supanich)

Approved by : 
(Mr. Prasit Kluaypa)

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

Date of Calibration : 13 Feb. 2023

Date of Issue : 13 Feb. 2023

Ref : 2011266011300149011

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.

Instrument Calibrated :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192016

Microphone : Type 7052NR No.73305

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 : 7-8 Feb. 2023

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E-mail : sumalee@tistr.or.th

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 : 7-8 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				
113.96	109.6	113.9	-0.1	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 115.7 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	14.7	0.10	N/A
C-Weight	20.6	0.10	N/A
Flat	24.6	0.10	N/A

Date of Calibration : 7-8 Feb. 2023

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response			Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.3	0.2	0.0	±1.5	0.45	0.6
1 000	-0.5	-0.5	-0.3	±1.0	0.45	0.6
8 000	-1.7	-1.7	-2.0	±5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response			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	-0.1	0.0	±2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	±3.0	0.20	0.6
8 000	-0.7	-0.7	-0.2	±5.0	0.20	0.7

Date of Calibration : 7-8 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)
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)
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)
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)
122	122.2	0.2	1.1	0.30	0.3
121	121.2	0.2	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.1	0.1	1.1	0.30	0.3
104	103.9	-0.1	1.1	0.30	0.3
99	99.1	0.1	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	79.2	0.2	1.1	0.30	0.3
74	74.2	0.2	1.1	0.30	0.3
69	69.2	0.2	1.1	0.30	0.3
64	64.1	0.1	1.1	0.30	0.3
59	59.1	0.1	1.1	0.30	0.3
54	54.1	0.1	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.2	0.2	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3
34	34.3	0.3	1.1	0.30	0.3

Date of Calibration : 7-8 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)
33	33.3	0.3	1.1	0.30	0.3
32	32.3	0.3	1.1	0.30	0.3
31	31.4	0.4	1.1	0.30	0.3
30	30.5	0.5	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

Date of Calibration : 7-8 Feb. 2023

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8. Level linearity including the level range control

At reference level at 5 dB greater than the signal level that first clause an indication of 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	45.1	0.1	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.5	0.5	1.1	0.30	0.3
20-100	25	25.6	0.6	1.1	0.30	0.3
20-90	25	25.4	0.4	1.1	0.30	0.3
20-80	25	25.2	0.2	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	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.7	-0.3	+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 : 7-8 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	(dB)	(±dB)	(±dB)	(±dB)
131.1	131.1	0.0	2.0	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	119.0	0.0	0.3	0.10	0.1
End	119.0				

Calibrated by : [Redacted]
(Mr. Pannasit Phasingsri)

Approved by : [Redacted]
(Mr. Panwate Klitayapa)
Director

Date of Calibration : 7-8 Feb. 2023

Date of Issue : 13 Feb. 2023

End of Certificate

Ref : 201126601300149018

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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.

Instrument Calibrated :	Ambient Environment
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. : 212014	
Microphone : 7052NR No.76235	
Preamplifier : -	

- Standards used :**
1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
 2. Condenser Microphone Brüel&Kjær 4180 S/N 289871.
 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 : 10 Feb. 2023

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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 : 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	114.1	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 114.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.9	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	13.4	0.10	N/A
C-Weight	19.0	0.10	N/A
Flat	23.9	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	-0.1	-0.1	1.5	0.45	0.6
1 000	-0.5	-0.5	-0.5	1.0	0.45	0.6
8 000	0.6	0.6	1.2	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	0.3	0.0	0.0	2.0	0.20	0.6
125	0.1	0.0	0.0	1.5	0.20	0.6
250	0.1	0.0	0.0	1.5	0.20	0.6
500	0.1	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	-0.3	-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	94.0	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

Date of Calibration : 10 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	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	74.1	0.1	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	49.0	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	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3
32	32.2	0.2	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

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	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	25.4	0.4	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.3	0.3	1.1	0.30	0.3
20-80	25	25.1	0.1	1.1	0.30	0.3

Date of Calibration : 10 Feb. 2023

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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	98.3	-0.7	+1.0; -2.5	0.20	0.3
	0.25	89.5	-0.5	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±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	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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: 
(Mr. Wittawat Supanich)

Approved by: 
(Mr. Pravithe Kluiyapa)

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: 2011266011300149006

End of Certificate 9 / 9

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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

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	93.92	-0.08	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	999.9	-0.1	± 1.5	±1.0%


3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&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: 
(Mr. Weerachai Deechaiyae)

Approved by: 
(Mr. Pravithe Kluiyapa)

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

Date of Calibration : 18 Jan. 2023

Date of Issue : 19 Jan. 2023

Ref: 2011266011300149001

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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 IC, 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 :**
- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 - Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.
 - Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 - Digital Multimeter Agilent 34401A S/N MY44005560.
 - Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 - Audio Analyzer Keithley 2015-P S/N 4106495.
 - Condenser Microphone Brüel&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

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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: 680
Gas Code: NO,NOX,SO2,BALN	Certification Date: Sep 05, 2018

Expiration Date: Sep 05, 2026

Calibration performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA-600/R-12/51, using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. 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.

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				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060825	CC442586	50.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
PRM	12368	9604119	29.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMS	7042910104	CC503841	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	14010327	KAL004376	49.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Apr 17, 2024

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

Triad Data Available Upon Request

NOTES: IPO# 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-600/R-12/51. 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. The document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

CERTIFICATE OF CALIBRATION

Certificate No. : CL-008-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-5028A
SERIAL NUMBER : 2926
ID NUMBER : -
CONDITION AS-RECEIVED : Used item
CUSTOMER : Integrated Research Center Company Limited,
 122 Moo 2, Thatoom, Srirachaphote, Prachinburi 25140,
 Thailand.

Calibration procedure:
 The Orifice gas flow device was calibrated against
 Standard Rotary Displacement Meter (Roots
 Meter) Model G65/IMC/W2-dp. The Wt-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: G221591

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.

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 ³ /min	Pressure [Pa] mmHg	Temperature [T _g] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice inH ₂ O	γ	Standard Flow [Q _s] m ³ /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	1.815	1.124
5	1.418	758.544	23.98	23.51	18.777	5.030	2.945	1.387

Slope (m): 1.62707
 Intercept (k): -0.01273
 Correlation coefficient (r): 0.99981
 Uncertainty (k=2): 0.015 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _g] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice inH ₂ O	γ	Standard Flow [Q _s] m ³ /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	1.815	1.124
5	1.418	758.544	23.98	23.51	18.777	5.030	2.945	1.385

Slope (m): 1.01912
 Intercept (k): -0.00799
 Correlation coefficient (r): 0.99981
 Uncertainty (k=2): 0.015 m³/min

End of Certificate of Calibration

Calibrated by:
 Mr. Sorawit Thachalad
 Miss Ittrapatorn Lertsomphol



Approved signatory: Mr. Parinya Booncharoen
 Calibration Department Manager



THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

Certificate of Calibration

Certificate Number : MBI-1843-2022

Page 1 of 2 Pages

Equipment : Electronic Balance
Manufacturer : Sartorius
Model : BSA224S-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.
 122 Moo 2, T. Thatoom,
 A. Srirachaphote, Prachinburi 25140
Date of Receipt : 28-Oct-22
Date of Calibration : 31-Oct-22
Location : WATER LAP IP-1

Condition of this result of calibration

- 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
 - This Certification is traceable to the International System of Unit maintained at : -
 - National Institute of Metrology (Thailand)
 - 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. Nathee Keumchalyapoom

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	0.00000

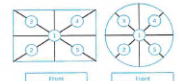
2. Error of indication from nominal value

Nominal Value (g)	Balance Reading (g)	Correction Value (g)	Uncertainty (±) (g)	factor k	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 :

FM-CL-11-05

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

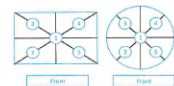
2. Error of indication from nominal value

Nominal Value (mg)	Balance Reading (mg)	Correction Value (mg)	Uncertainty (±) (mg)	factor k	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

