

บริษัท อินทิเกรทเต็ด รีเสิร์ช เซ็นเตอร์ จำกัด

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**MEASUREMENT RESULTS:**

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

**Table 1: The results of Q Standard calibration data**

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [T <sub>a</sub> ] °C	Temperature [T <sub>m</sub> ] °C	Δp <sub>meter</sub> mmHg	Δp <sub>Orifice</sub> inH <sub>2</sub> O	γ	Standard Flow [Q <sub>s</sub> ] m <sup>3</sup> /min
1	0.705	758.329	24.44	23.77	50.462	1.122	1.059	0.659
2	1.001	758.356	24.29	23.90	36.610	2.376	1.542	0.954
3	1.117	758.415	24.01	23.47	31.484	3.004	1.734	1.074
4	1.166	758.484	23.86	23.34	29.640	3.290	1.815	1.124
5	1.418	758.544	23.98	23.51	18.777	5.030	2.245	1.387

Slope (m): 1.62707

Intercept (b): -0.01273

Correlation coefficient (r): 0.99981

Uncertainty (k=2): 0.015 m<sup>3</sup>/min

**Table 2: The results of Q actual calibration data**

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

Slope (m): 1.01912

Intercept (b): -0.00799

Correlation coefficient (r): 0.99981

Uncertainty (k=2): 0.015 m<sup>3</sup>/min

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



Certificate No. : CL-008-66

Page 1 of 2 Pages

**MEASUREMENT ITEM**

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

: Top Load Orifice

: TISCH

: TE-5028A

: 2926

: -

: Used item

: Integrated Research Center Company Limited.

: 122 Moo 2, Thatoom, Srirachaphote, Prachinburi 25140,

: Thailand.

RECEIVED DATE

: 20 Mar 2023

MEASUREMENT DATE

: 24 Apr 2023

ISSUE DATE

: 24 Apr 2023

**ENVIRONMENTAL CONDITIONS:**

Ambient condition in the laboratory are as follow:

Temperature

: 23.0 ± 3.0 °C

Relative Humidity

: 55.0 ± 15.0 %RH

Atmospheric Pressure

: 1010 ± 10 hPa

**CALIBRATION CONDITION:**

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

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

**TABULATION OF RESULTS:**

The table on next page give the measured values.

**Calibration procedure:**

The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IN/C/W2-50. The W6-CE-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: 02211901

**Uncertainty of Measurement:**

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

Calibrated by:  
☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn 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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

**CALIBRATION CERTIFICATE**

Submitted by

: Integrated Research Center Company Limited.

Address

: 122 Moo 2 T.Thatoom, A.Srirachaphote, 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

: -

**Standards used :**

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

Date of Receipt

: 13 Jan. 2023

Date of Calibration

: 13 Feb. 2023

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FM.B.MTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

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

**Calibration Procedure :**

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

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

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

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

Date of Calibration : 13 Feb. 2023

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### 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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### 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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### 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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## 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

Date of Calibration : 13 Feb. 2023

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## 10. Peak C sound level

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

## 11. Overload indication

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

## 12. High-level stability

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

Calibrated by :

*Without Signature*  
(Mr. Wittawat Supanich)

Approved by :

*Prasit Prayuth*  
(Mr. Prasit Prayuth)

**Director**  
**Electrical and Electronic Standards Laboratory**  
**Industrial Metrology and Testing Service Center**

Date of Calibration : 13 Feb. 2023

Date of Issue : 13 Feb. 2023

Ref : 2011266011300149010

End of Certificate

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## 8. Level linearity including the level range control

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

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

## 9. Tone burst response

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

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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. : 00433730

Microphone : UC-52 No.144953

Preamplifier : NH-24 No.33780

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 : 7 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 : 7 Feb. 2023

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

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	-0.1	0.0	0.0	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

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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

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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 : 7 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	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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## 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)
85	85.0	85.0	0.0	1.1	0.30	0.3
80-130	75	75.0	0.0	1.1	0.30	0.3
70-120	65	65.0	0.0	1.1	0.30	0.3
60-110	55	54.9	-0.1	1.1	0.30	0.3
50-100	45	44.9	-0.1	1.1	0.30	0.3
40-90	35	35.0	0.0	1.1	0.30	0.3
30-80	25	24.9	-0.1	1.1	0.30	0.3
20-70						

## 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	116.1	0.1	±1.0	0.20	0.3
	2	99.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	90.0	0.0	+1.5; -5.0	0.20	0.3
Slow	200	109.6	0.0	±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	81.0	0.0	+1.5; -5.0	0.20	0.3

Date of Calibration : 7 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	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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## 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	1.5	0.20	0.25
136.6	136.6	0.0	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	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by : *Wittawat Supanich*  
(Mr. Wittawat Supanich)

Approved by : *Prasit Kluayap*  
(Mr. Prasit Kluayap)  
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 : 2011266011300149007

End of Certificate

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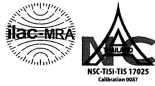
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## Certificate of Calibration

**Equipment:** Balance  
**Model:** BSA224S-CW  
**Serial No. (or ID.):** 34490341  
**Manufacturer:** Sartorius  
**Condition:** In condition


**Certificate No.:** C01233749  
**Issued Date:** 03 November 2023  
**Job No.:** WO-00008313  
**Page:** 1 of 2

**Customer:** Integrated Research Center Co.,Ltd.  
122 Moo 2, Tambol Thatoom,  
Amphur Srimahaphote, Prachinburi 25140 Thailand

**Environment Condition:** Temperature 23 °C ± 0.5 °C  
Humidity 61 %RH ± 4.3 %RH

**Calibration Place:** Double A (1991) Public Company Limited.  
(Water Laboratory IP1 (Balance Room))  
1 Moo 2, Thatoom, Srimahaphot,  
Prachinburi 25140 Thailand.

**Calibration By:** Mr. Piyapat Saidoung  
**Calibration Date:** 02 November 2023  
**The Method used:** In-house method, CAL-WI-47, based on UKAS Lab 14  
**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02222418

  
(Mr. Piyapat Saidoung)  
Person in charge

  
(Mr. Rungrod Jenkitrakulchai)  
Authorized signatory

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

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CAL-FM-C01-14: 12 Sep 2022



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Page: 2 of 2

### Calibration Results:

#### Without Adjustment

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

(a)	(b)	(c)	Nominal Test Value	100	(g)
Reference Points (g)					
A	B	C	D	E	
-	-0.0001	0.0000	0.0001	-0.0001	

**Repeatability:** Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00006

**Error of indication from nominal or conventional mass value.,** Readability 0.0001 (g)

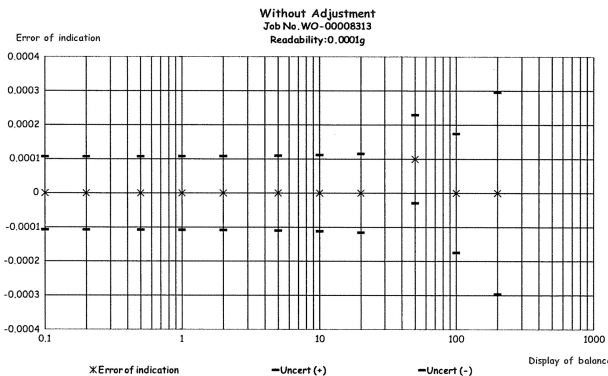
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of indication (g)	Uncertainty (g)	k
0.1	0.10000	0.1000	0.0000	0.00011	2.04
0.2	0.20000	0.2000	0.0000	0.00011	2.04
0.5	0.50000	0.5000	0.0000	0.00011	2.04
1	1.00000	1.0000	0.0000	0.00011	2.04
2	2.00001	2.0000	0.0000	0.00011	2.04
5	4.99999	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	19.99998	20.0000	0.0000	0.00012	2.03
50	49.99994	50.0000	0.0001	0.00013	2.02
100	99.99997	100.0000	0.0000	0.00017	2.01
200	199.99993	199.9999	0.0000	0.00030	2.00

The End of Certificate

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CAL-FM-C01-14: 12 Sep 2022



### ใบตรวจสอบสภาพเครื่องชั่ง

เลขที่ใบงาน: WO-00008313  
ชนิดเครื่องมือ: Balance      รุ่น: BSA224S-CW      หมายเลขเครื่อง: 34490341

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
02 Nov 2023			02 Nov 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ/Adapter, power supply 220/110V	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสมบูรณ์ชุดกระดกกันลม (Cover)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. ความสมบูรณ์ชุดของระดับน้ำ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การปรับระดับของขาตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. การตอบสนองของปุ่มกด	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. ความสมบูรณ์ของ Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. การแสดงผลของ Display หลังจางน้ำหนัก	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ชุดรองจานชั่ง (Stopper) / pan support	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. การทำงานของ Function Internal / External	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. ความสะอาดของตัวเครื่องภายนอกและภายใน load cell	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

หมายเหตุเพิ่มเติม/ข้อแนะนำ :

Mr. Piyapat Saidoung  
Service Engineer

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