

**SOUND LEVEL CALIBRATOR**

**MODEL : NC-75**

**SERIAL No. : 34802645**

Request No. 21-65/0018

MTC No. EEL. BP. 24/1064

## CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.  
Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.  
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-75  
Serial No. : 34802645  
Ambient Environment  
Temperature : (23 ± 3) °C  
Relative Humidity : (50 ± 15) %  
Ambient Pressure : (101.325 ± 1.500) kPa

### Standards used :

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

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

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

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

Date of Receipt : 11 Oct. 2021

Date of Calibration : 21 Oct. 2021

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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
1/2 inch B&K 4180	93.97	-0.03	± 0.10	±0.40 dB

#### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch B&K 4180	1000.0	0.0	± 1.5	±1.0%

#### 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch B&K 4180	0.50	± 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 :

Approved by :

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 21 Oct. 2021

Date of Issue : 26 Oct. 2021

Ref. : 2011264101104187003

End of Certificate

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FMBL/MTC.002 Rev.4

**SOUND LEVEL METER**

**MODEL : 6226**

**SERIAL No. : 090086**

Request No. 21-65/0401

MTC No. EEL. BP. 98/0365

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.

**Address** : 683 Moo 11 Sukapitbal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

**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 : 6226

Serial No. : 090086

Microphone : Type 7052 No.65739

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. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Date of Receipt** : 22 Mar. 2022

**Date of Calibration** : 20-21 Apr. 2022

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FM.BLMTC-002 Rev.4

Request No. 21-65/0401

MTC No. EEL. BP. 98/0365

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 (2006). 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** : 20-21 Apr. 2022

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	
	Before adjust	After adjust		
113.96	114.2	114.0	0.0	0.30
				1.4

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.5 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
21.1	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	16.5	0.10
C-Weighting	26.3	0.10
Flat	30.9	0.10

Date of Calibration : 20-21 Apr. 2022

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.3	0.1	0.1	0.40	2.0
1 000	-0.3	-0.3	-0.3	0.40	1.4
4 000	0.3	0.4	0.6	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	-0.1	0.1	-0.1	0.20	2.5
125	0.3	0.1	0.1	0.20	2.0
250	0.3	0.1	0.0	0.20	1.9
500	0.2	0.1	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	-0.1	-0.1	0.20	2.6
4 000	-0.4	-0.2	-0.1	0.20	3.6
8 000	-0.4	-0.2	-0.3	0.20	5.6

Date of Calibration : 20-21 Apr. 2022

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## 5. Frequency and time weightings at 1 kHz

### 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.1	0.1	0.20	0.4

### 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.1	0.1	0.20	0.3

## 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
122	121.9	-0.1	0.30	1.4
121	120.9	-0.1	0.30	1.4
120	120.0	0.0	0.30	1.4
119	118.9	-0.1	0.30	1.4
114	113.9	-0.1	0.30	1.4
109	108.9	-0.1	0.30	1.4

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## 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
104	103.9	-0.1	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	88.9	-0.1	0.30	1.4
84	84.0	0.0	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	63.8	-0.2	0.30	1.4
59	58.9	-0.1	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
33	33.0	0.0	0.30	1.4
32	32.1	0.1	0.30	1.4
31	31.1	0.1	0.30	1.4
30	30.2	0.2	0.30	1.4

Date of Calibration : 20-21 Apr. 2022

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	84.9	-0.1	0.30	1.4
20-80	75	74.9	-0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.8	-0.2	0.20	±1.3
	2	98.9	-0.1	0.20	+1.3; -2.8
	0.25	89.3	-0.7	0.20	+1.8; -5.3
Slow	200	109.4	-0.2	0.20	±1.3
	2	89.9	-0.1	0.20	+1.3; -5.3
	200	110.1	0.1	0.20	±1.3
SEL	2	90.1	0.1	0.20	+1.3; -2.8
	0.25	81.1	0.1	0.20	+1.8; -5.3

Date of Calibration : 20-21 Apr. 2022

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Complete cycle	125.4	125.4	0.0	0.20	2.4
Positive half cycle	124.4	124.2	-0.2	0.20	1.4
Negative half cycle	124.4	124.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	132.9	0.0	0.30	1.8

Calibrated by :

Approved by :



Electrical and Microelectronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 20112650322013300002

End of Certificate

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**SOUND LEVEL METER**

**MODEL : 6226**

**SERIAL No. : 090087**





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

MTC No. EEL. BP. 39/0664

Request No. 21-64/0618

9. Power Amplifier Briel&Kjaer 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 (2006). 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 : 1-2 Jul. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

MTC No. EEL. BP. 39/0664

Request No. 21-64/0618

### CALIBRATION CERTIFICATE

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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 : 6226  
Serial No. : 090087  
Microphone : Type 7052 No.44776  
Preamplifier : -

Ambient Environment  
Temperature :  $(23 \pm 3) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 15) \%$   
Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$

#### Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Briel&Kjaer 4180 S/N 2633526.
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 Briel&Kjaer 2636 S/N 1537484.

Date of Receipt : 8 Jun. 2021

Date of Calibration : 1-2 Jul. 2021

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Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592

### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 ( $\pm$ dB)	
	Measured Value (dB)		Deviation (dB)		
	Before adjust	After adjust			
113.92	114.2	113.9	0.0	0.30	1.4

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.3 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
20.4	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	13.1	0.10
C-Weighting	22.2	0.10
Flat	25.2	0.10

Date of Calibration : 1-2 Jul. 2021

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

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	F at (dB)		
125	0.3	0.3	0.2	0.40	2.0
1 000	-0.2	-0.2	-0.2	0.40	1.4
4 000	-1.2	-1.5	-1.2	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.3	0.1	0.1	0.20	2.5
125	0.2	0.2	0.2	0.20	2.0
250	0.1	0.1	0.1	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	0.0	0.1	0.20	2.6
4 000	-0.3	-0.1	0.0	0.20	3.6
8 000	-0.3	-0.2	-0.1	0.20	5.6

Date of Calibration : 1-2 Jul. 2021

4 /

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0618

MTC No. EEL. BP. 39/0664

### 5. Frequency and time weightings at 1 kHz

#### 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.1	0.1	0.20	0.4

#### 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

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### 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
122	121.9	-0.1	0.30	1.4
121	120.9	-0.1	0.30	1.4
120	119.9	-0.1	0.30	1.4
119	118.9	-0.1	0.30	1.4
114	113.9	-0.1	0.30	1.4
109	108.9	-0.1	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

5 / 8

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0618

MTC No. EEL. BP. 39/0664

### 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
104	103.9	-0.1	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.0	0.0	0.30	1.4
79	78.9	-0.1	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	63.8	-0.2	0.30	1.4
59	58.8	-0.2	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	48.8	-0.2	0.30	1.4
44	43.9	-0.1	0.30	1.4
39	38.8	-0.2	0.30	1.4
34	33.9	-0.1	0.30	1.4
33	32.9	-0.1	0.30	1.4
32	32.0	0.0	0.30	1.4
31	31.0	0.0	0.30	1.4
30	30.0	0.0	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

6 / 8

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	74.9	-0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, T <sub>b</sub> (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.6	-0.4	0.20	±1.3
	2	98.7	-0.3	0.20	+1.3; -2.8
	0.25	89.6	-0.4	0.20	+1.8; -5.3
Slow	200	109.5	-0.1	0.20	±1.3
	2	89.9	-0.1	0.20	+1.3; -5.3
	200	110.1	0.1	0.20	±1.3
SEL	2	90.2	0.2	0.20	+1.3; -2.8
	0.25	81.2	0.2	0.20	+1.8; -5.3

Date of Calibration : 1-2 Jul. 2021

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (+dB)	Tolerance limits Class 2 (+dB)
Complete cycle	125.4	125.7	0.3	0.20	2.4
Positive half cycle	124.4	124.2	-0.2	0.20	1.4
Negative half cycle	124.4	124.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
133.0	133.0			

Calibrated by :

Approved by :



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

Ref : 2011264060802448001

End of Certificate

8 /

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

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E-mail : mtc@tistr.or.th



**Area Heat Stress Monitor**

**Model : QUESTemp 32**

**Serial No. : TPI050070**



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ISO-MRA  
NO. 17025  
CALIBRATION

## CALIBRATION CERTIFICATE

Certificate No. : AD2202-233-0001

Date Issued : 23-Feb-22

"Supplement to Calibration Certificate No. AD2202-233-0001, date issued 23-Feb-22, page 1 of 2"

Customer : Eastern Thai Consulting 1992 Co., Ltd.

683 Moo 11 Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

Equipment : Area Heat Stress Monitor

Manufacturer : Quest Technology

Model : QUESTemp 32

Serial No. : TP1050070

ID No./Tag No. : 3

Date Received : 18-Feb-22

Date Calibrated : 21-Feb-22

Calibrated by : Ms. Yaowanuch Jirakiatikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2  
COPY

Certificate No. : AD2202-233-0001

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 15)\%\text{RH}$

STD Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ )		UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $\pm ^\circ\text{C}$ )
	Before Adjusted	After Adjusted		
38.00	WET 38.1	-	0.10	0.35
38.00	DRY 38.1	-	0.10	0.35
38.00	GLOBE 37.9	-	-0.10	0.35
44.98	WET 44.8	-	-0.18	0.35
44.98	DRY 44.8	-	-0.18	0.35
44.98	GLOBE 44.9	-	-0.08	0.35

STD = Standard

UUC = Unit Under Calibration

Description of UUC :  
Range 0 to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

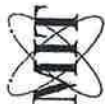
MIT Certificate No. AD2111-077-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 11-Nov-22

End of Certificate

**Area Heat Stress Monitor**

**Model : QUESTemp 32**

**Serial No. : TPH060001**



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## CALIBRATION CERTIFICATE

Certificate No. : AD2105-181-0001

Date Issued : 24-May-21

**Customer** : Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhaphibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

**Equipment** : Area Heat Stress Monitor

**Manufacturer** : TSI

**Model** : QUESTemp 32

**Serial No.** : TPH060001

**ID No./Tag No.** : -

**Date Received** : 18-May-21

**Date Calibrated** : 19-May-21

**Calibrated by** : Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No. : AD2105-181-0001

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

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

STD Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ )		UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $\pm ^\circ\text{C}$ )
	Before Adjusted	After Adjusted		
38.01	WET 38.0	-	-0.01	0.35
38.01	DRY 37.9	-	-0.11	0.35
38.01	GLOBE 38.0	-	-0.01	0.35
45.01	WET 45.0	-	-0.01	0.35
45.01	DRY 44.9	-	-0.11	0.35
45.01	GLOBE 45.0	-	-0.01	0.35

STD = Standard

UUC = Unit Under Calibration

Description of UUC :

Range 0 to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2011-059-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 13-Nov-21

End of Certificate

Page 2 of 2

**Area Heat Stress Monitor**

**Model : QUESTemp 32**

**Serial No. : TPL060039**



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## CALIBRATION CERTIFICATE

Certificate No. : AD2105-306-0001

Date Issued : 03-Jun-21

**Customer** : Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhapibam 8 Rd., Nongkham, Sriracha, Chonburi 20230

**Equipment** : Area Heat Stress Monitor

**Manufacturer** : Quest Technologies

**Model** : QUESTemp 32

**Serial No.** : TPL060039

**ID No./Tag No.** : 4

**Date Received** : 31-May-21

**Date Calibrated** : 02-Jun-21

**Calibrated by** : Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No. : AD2105-306-0001

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 15)\% \text{RH}$

STD Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ )	Before Adjusted	After Adjusted	UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $^\circ\text{C}$ )
38.01	WET	38.0	-	-0.01	0.35
38.01	DRY	37.9	-	-0.11	0.35
38.01	GLOBE	37.9	-	-0.11	0.35
44.99	WET	45.0	-	0.01	0.35
44.99	DRY	45.0	-	0.01	0.35
44.99	GLOBE	45.0	-	0.01	0.35

STD = Standard

UUC = Unit Under Calibration

Description of UUC :

Range 0 to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2011-059-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 13-Nov-21

End of Certificate

Page 2 of 2

**Area Heat Stress Monitor**

**Model : QUESTemp 32**

**Serial No. : TPL060040**





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## CALIBRATION CERTIFICATE

Certificate No. : AD2105-306-0002

Date Issued : 03-Jun-21

**Customer** : Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

**Equipment** : Area Heat Stress Monitor

**Manufacturer** : Quest Technologies  
**Model** : QUESTemp 32  
**Serial No.** : TPL060040  
**ID No./Tag No.** : 5  
**Date Received** : 31-May-21  
**Date Calibrated** : 02-Jun-21

**Calibrated by** : Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No. : AD2105-306-0002

**Environment** : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 15)\%\text{RH}$

STD	UUC Reading ( $^\circ\text{C}$ )		UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $^\circ\text{C}$ )
	Before Adjusted	After Adjusted		
38.01	WET 38.1	-	0.09	0.35
38.01	DRY 38.0	-	-0.01	0.35
38.01	GLOBE 37.9	-	-0.11	0.35
44.99	WET 44.9	-	-0.09	0.35
44.99	DRY 45.0	-	0.01	0.35
44.99	GLOBE 44.9	-	-0.09	0.35

STD = Standard

UUC = Unit Under Calibration

**Description of UUC :**  
Range 0 to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

### Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2011-059-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 13-Nov-21

End of Certificate

Page 2 of 2



**Area Heat Stress Monitor**

**Model : QUESTemp 34**

**Serial No. : TEU080015**



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Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



## CALIBRATION CERTIFICATE

Certificate No. : AD2108-174-0003

Date Issued : 20-Aug-21

**Customer** : Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

**Equipment** : Area Heat Stress Monitor

**Manufacturer** : TSI

**Model** : QUESTemp34

**Serial No.** : TEU080015

**ID No./Tag No.** : 14

**Date Received** : 17-Aug-21

**Date Calibrated** : 19-Aug-21

**Calibrated by** : Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No. : AD2108-174-0003

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 15)\%\text{RH}$

STD	Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ )	Before Adjusted	After Adjusted	UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $\pm ^\circ\text{C}$ )
	38.00	WET	38.1	-	0.10	0.35
	38.00	DRY	38.1	-	0.10	0.35
	38.00	GLOBE	38.1	-	0.10	0.35
	44.99	WET	45.1	-	0.11	0.35
	44.99	DRY	45.1	-	0.11	0.35
	44.99	GLOBE	45.1	-	0.11	0.35

STD = Standard

UUC = Unit Under Calibration

Description of UUC :  
Range (-5) to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

### Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2011-059-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 13-Nov-21

End of Certificate

Page 2 of 2

**Area Heat Stress Monitor**

**Model : QUESTemp 34**

**Serial No. : TEU080014**



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD  
214 Bangwaek Rd. Bangpai Bangkok 10160  
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



## CALIBRATION CERTIFICATE

Certificate No. : AD2108-174-0001  
Date Issued : 20-Aug-21

**Customer** : Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhapibam 8 Rd., Nongkham, Sriracha, Chonburi 20230

**Equipment** : Area Heat Stress Monitor

**Manufacturer** : TSI

**Model** : QUESTemp34

**Serial No.** : TEU080014

**ID No./Tag No.** : 13

**Date Received** : 17-Aug-21

**Date Calibrated** : 19-Aug-21

**Calibrated by** : Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No. : AD2108-174-0001

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 15)\%\text{RH}$

STD Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ ) Before Adjusted	After Adjusted	UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $\pm ^\circ\text{C}$ )
38.00	WET 38.1	-	0.10	0.35
38.00	DRY 38.1	-	0.10	0.35
38.00	GLOBE 37.9	-	-0.10	0.35
44.99	WET 45.0	-	0.01	0.35
44.99	DRY 45.0	-	0.01	0.35
44.99	GLOBE 44.9	-	-0.09	0.35

STD = Standard

UUC = Unit Under Calibration

Description of UUC :

Range (-5) to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2011-059-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603. Due 13-Nov-21

End of Certificate

Page 2 of 2

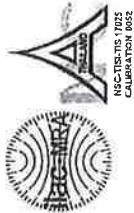
**Area Heat Stress Monitor**

**Model : QUESTemp 34**

**Serial No. : TPL090017**



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Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



## CALIBRATION CERTIFICATE

Certificate No.: AD2202-037-0001

Date Issued : 08-Feb-22

### Customer

: Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhapibarn 8 Rd., Nongkham, Sriracha, Chonburi 20230

### Equipment

: Area Heat Stress Monitor

### Manufacturer

: 3M

### Model

: QUESTemp34

### Serial No.

: TPL090017

### ID No./Tag No.

: No.7

### Date Received

: 02-Feb-22

### Date Calibrated

: 07-Feb-22

### Calibrated by

: Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No.: AD2202-037-0001

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 15)\%\text{RH}$

STD	Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ )	UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $\pm ^\circ\text{C}$ )
		Before Adjusted	After Adjusted	
37.97	WET	37.8	-	0.35
37.97	DRY	37.7	-	0.35
37.97	GLOBE	38.0	0.03	0.35
44.98	WET	44.7	-0.28	0.35
44.98	DRY	44.6	-0.38	0.35
44.98	GLOBE	44.8	-0.18	0.35

STD = Standard

UUC = Unit Under Calibration

### Description of UUC :

Range :  $0 \text{ to } 100 ^\circ\text{C}$   
Resolution :  $0.1 ^\circ\text{C}$

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2111-077-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 11-Nov-22

End of Certificate

Page 2 of 2

**Area Heat Stress Monitor**

**Model : QUESTemp 32**

**Serial No. : TPL090016**



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## CALIBRATION CERTIFICATE

Certificate No. : AD2109-161-0001

Date Issued : 21-Sep-21

**Customer** : Eastern Thai Consulting 1992 Co., Ltd.  
683 Moo 11 Sukhapibarn 8 Rd., Nongkhram, Sriracha, Chonburi 20230

**Equipment** : Area Heat Stress Monitor

**Manufacturer** : QUEST TECHNOLOGIES

**Model** : QUESTemp 32

**Serial No.** : TPL090016

**ID No./Tag No.** : NO 6

**Date Received** : 14-Sep-21

**Date Calibrated** : 18-Sep-21

**Calibrated by** : Ms. Yaowanuch Jirakiattikul

### Calibration Method or Calibration Procedure Used

In-house method : CP-19 by comparing against Standard Digital Humidity / Temperature Meter

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

### Result of Calibration

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

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Approved by :



Page 1 of 2

Certificate No. : AD2109-161-0001

Environment : Ambient Temperature :  $(25 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(50 \pm 15)\%\text{RH}$

STD Reading ( $^\circ\text{C}$ )	UUC Reading ( $^\circ\text{C}$ ) Before Adjusted	After Adjusted	UUC Error ( $^\circ\text{C}$ )	Measurement Uncertainty ( $\pm ^\circ\text{C}$ )
38.00	WET 38.1	-	0.10	0.35
38.00	DRY 37.9	-	-0.10	0.35
38.00	GLOBE 37.9	-	-0.10	0.35
45.00	WET 45.0	-	0.00	0.35
45.00	DRY 44.8	-	-0.20	0.35
45.00	GLOBE 45.1	-	0.10	0.35

STD = Standard

UUC = Unit Under Calibration

Description of UUC :

Range 0 to 100  $^\circ\text{C}$   
Resolution 0.1  $^\circ\text{C}$

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. AD2011-059-0001 for Digital Thermometer with Probe (Fluke) Serial No. 5856603, Due 13-Nov-21

End of Certificate

Page 2 of 2

COPI



**Area Heat Stress Monitor**

**Model : QUESTemp 34**

**Serial No. : TEU080013**



## SUMMARY REPORT

WORK ORDER: 953089

7/7/2021

**Related Event Type** CALIBRATION - ACCRED  
**Model Name** QUESTEMP 34 HS MONITOR  
**Serial Number** TEU080013  
**Performed By** BRYAN RASMUSSEN  
**Repair Notes:** The unit was very far out of tolerance. Calibrating the unit brought the values back into tolerance. This unit passed calibration and test.

## Certificate of Calibration

Certificate No: 953089 TEU080013

**Submitted By:**  
KEIKA VENTURES  
132 RAND PARK DR  
GARNER, NC 27529-7362

**Serial Number:** TEU080013  
**Customer ID:** QUESTEMP 34 HS MONITOR  
**Model:**  
**Test Conditions:**  
Temperature: 18°C to 29°C  
Humidity: 20% to 80%  
Barometric Pressure: 890 mbar to 1050 mbar  
**As Found:** OUT OF TOLERANCE  
**As Left:** IN TOLERANCE

**Subassemblies:**  
**Description:** SENSOR BAR ASSEMBLY W/HUM.  
**Serial Number:** TEU080013

**Calibration Procedure:** 56V792  
**Reference Standard(s):**  
I.D. Number Device  
ET0000627 FLUKE 1524 REF THERMOMETER W/ PROBE 2/22/2021  
**Measurement Uncertainty:**  
+/- 0.06 °C  
Estimated at 95% Confidence Level (k=2)

**Last Calibration Date:** Calibration Due 2/22/2023

**Calibrated By:**

**Reviewed By:**

7/7/2021

7/7/2021

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified under equipment above. This report must not be reproduced except in its entirety without the written approval of TSI Incorporated.

The unit is found to have passed when the readings are within the specification limits of the device as represented as the allowable range stated (tolerance - to tolerance +) with each measurement on page 2. The customer shall assess the results and uncertainty in order to determine if the results meet their needs.

## **DIGITAL LIGHT METER**

**Model : LX-72**

**Serial No. : Q606412**



## CALIBRATION CERTIFICATE

Issued date : 9 August 2021

Client Name : **EASTERN THAI CONSULTING 1992 CO., LTD.**

Address : 683 Moo 11, Sukhaphibal 8 Rd., Nongkham, Si racha, Chonburi 20230

Request No : **C-2108 - 400**

Laboratory No.: **CAL- 400**

Date of Request : 4 August 2021.

Date of Calibration : 6 August 2021.

### 1. Unit Under Calibration ( UUC ) :

Nomenclature : Digital Light Meter

Maker : DIGICON

Serial No.: Q606412

Model : LX-72

2. Place of Calibration : Photometry Standard Laboratory, INTERNATIONAL TESTING SERVICE CO., LTD.

3. Range of Calibration : 3 Range

4. Condition of Laboratory : Ambient temperature : (25 ± 2) °C and relative humidity (60 ± 20) %.

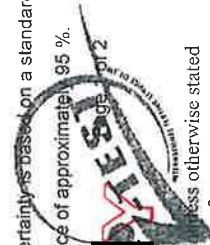
5. Reference Standard : Standard Tungsten Halogen Lamp , Serial No.: 504006, which was calibrated on 7 April, 2021, can be traceable to International System of Unit (SI) through Electrical and Electronics Institute Foundation for Industrial development, Certificate No.: 0050LI21.

### 6. Support Equipment :

1. Photometric bench , 6.3 meter long.
2. DC. power supply, Serial No.: EJ 19A 009, Model : GPR-25H 300 . Maker : GW INSTR.
3. Digital Multimeter , Model : 34401A , S/N : MY44011212 and MY44011215.
4. Foot Candle / Lux Meter , Model : 407026, S/N : Q 558437, Maker : EXTECH.

### 7. Calibration Procedure :

The measurement was done in accordance with WI-CP-01. The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 %.



The Results shown in this certification report refer only to the equipment(s) calibrated unless otherwise stated  
This Calibration Certificate cannot be reproduced, except in full, without permission of company.



Request No : **C-2108 - 400**

Laboratory No.: **CAL - 400**

Serial No.: Q606412

### Results :

UUC Range	Standard (Ix)	Unit Under Calibration Reading ( Ix )	Correction (Ix)	Uncertainty of Measurement ( + Ix )
400	0	---	-	-
	50	47.3	+ 2.7	
	100	96.3	+ 3.7	
	200	193.5	+ 6.5	
	300	285.6	+ 14.4	
4000	400	378.8	+ 21.2	
	500	473	+ 27	
	1000	962	+ 38	
	2000	1950	+ 50	
	3000	2923	+ 77	
40000 x10	4000	3830	+ 170	
	5000	477	+ 230	

Note: The UUC cannot be adjusted anymore.

Calibration result approved by

Approved on behalf of  
International Testing Service Co., Ltd



The Results shown in this certification report refer only to the equipment(s) calibrated unless otherwise stated  
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**SOUND LEVEL CALIBRATOR**

**MODEL : NC-75**

**SERIAL No. : 34802645**



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0018

MTC No. EEL BP. 24/1064

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.  
**Address** : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.  
**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-75  
**Serial No.** : 34802645

### Ambient Environment

**Temperature** : (23 ± 3) °C  
**Relative Humidity** : (50 ± 15) %  
**Ambient Pressure** : (101.325 ± 1.500) kPa

### Standards used :

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

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

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

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

**Date of Receipt** : 11 Oct. 2021

**Date of Calibration** : 21 Oct. 2021

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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0018

MTC No. EEL BP. 24/1064

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
1/2 inch B&K 4180	93.97	-0.03	± 0.10	±0.40 dB

### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch B&K 4180	1000.0	0.0	± 1.5	±1.0%

### 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch B&K 4180	0.50	± 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 :



Approved by :



**Date of Calibration** : 21 Oct. 2021  
**Date of Issue** : 26 Oct. 2021

End of Certificate

Ref: 2017/2561/0104187003

2 / 2

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**SOUND LEVEL METER**

**MODEL : NL-42**

**SERIAL No. : 00646443**



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0101

MTC No. EEL. BP. 60/1164

## CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

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. : 00646443 (No.24)

Microphone : Type UC-52 No.155616

Preamplifier : Type NH-24 No.43423

### 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. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 17 Nov. 2021

Date of Calibration : 1-2 Dec. 2021

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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0101

MTC No. EEL. BP. 60/1164

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 (2006). 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 : 1-2 Dec. 2021

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

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E-mail : sumalee@tistr.or.th



### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test		Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation	
	Before adjust	After adjust	
113.92	113.9	113.9	0.0
			0.30
			1.4

Note: The external calibration adjustment was firstly performed. The internal calibrator adjustment was then completed at the display of 112.5 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
25.1	0.10

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

Frequency	Measured Value (dB)	Uncertainty (±dB)
Weighting	24.5	0.10
A-Weighting	24.5	0.10
C-Weighting	24.5	0.10
Flat	28.2	0.10

Date of Calibration : 1-2 Dec. 2021

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E-mail : mtalee@tistr.or.th

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	-0.2	0.0	0.0	0.40	2.0
1 000	-0.1	-0.1	-0.1	0.40	1.4
4 000	-0.3	-0.3	-0.3	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	-0.3	-0.2	-0.2	0.20	2.5
125	-0.2	-0.1	-0.1	0.20	2.0
250	-0.2	-0.1	-0.1	0.20	1.9
500	-0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.0	0.20	2.6
4 000	0.1	0.0	0.0	0.20	3.6
8 000	0.1	0.1	0.1	0.20	5.6

Date of Calibration : 1-2 Dec. 2021

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

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
137	136.0	-1.0	0.30	1.4
136	135.4	-0.6	0.30	1.4
135	134.7	-0.3	0.30	1.4
134	133.9	-0.1	0.30	1.4
133	133.0	0.0	0.30	1.4
132	132.0	0.0	0.30	1.4
131	131.0	0.0	0.30	1.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
130	130.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.0	0.0	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	58.9	-0.1	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.1	0.1	0.30	1.4
34	34.5	0.5	0.30	1.4
29	30.3	1.3	0.30	1.4
28	29.7	1.7	0.30	1.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
27	28.9	1.9	0.30	1.4
26	28.4	2.4	0.30	1.4
25	27.7	2.7	0.30	1.4

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-130	125	125.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	126.0	0.0	0.20	±1.3
	2	108.9	-0.1	0.20	+1.3; -2.8
	0.25	99.9	-0.1	0.20	+1.8; -5.3
Slow	200	119.5	-0.1	0.20	±1.3
	2	99.9	-0.1	0.20	+1.3; -5.3
	200	120.0	0.0	0.20	±1.3
SEL	2	100.0	0.0	0.20	+1.3; -2.8
	0.25	90.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 1-2 Dec. 2021

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

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.2	-0.2	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
136.7	136.7			

Calibrated by :



(Mr. Tawikiat Iamsamran)

Date of Calibration : 1-2 Dec. 2021

Date of Issue : 15 Dec. 2021

End of Certificate

Ref: 2011264121704770002

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**Office**  
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E-mail : sumalee@tistr.or.th

FM.BLMTC002 Rev.4

**SOUND LEVEL METER**

**MODEL : NL-21**

**SERIAL No. : 00443357**





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL BP. 15/1164

## CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co.,Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi, 20230.

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-21

Serial No. : 00443357 (No.12)

Microphone : Type UC-52 No.153070

Preamplifier : Type NH-21 No.11330

### 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 : 5 Nov. 2021

Date of Calibration : 8-10 Nov. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0071

MTC No. EEL BP. 15/1164

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 (2006). 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 : 8-10 Nov. 2021

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
113.90	114.0	113.9	0.0	0.30	1.4

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 116.2 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
23.0	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	21.0	0.10
C-Weighting	28.0	0.10
Flat	34.1	0.10

Date of Calibration : 8-10 Nov. 2021

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.4	0.4	0.2	0.40	2.0
1 000	-0.3	-0.3	-0.2	0.40	1.4
4 000	-0.8	-0.7	-0.8	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.0	0.0	-0.2	0.20	2.5
125	0.0	0.0	-0.1	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.0	0.1	0.1	0.20	3.6
8 000	0.2	0.2	0.1	0.20	5.6

Date of Calibration : 8-10 Nov. 2021

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FM.BL.MTC.002 Rev

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 8-10 Nov. 2021

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6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.1	0.1	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
33	33.1	0.1	0.30	1.4
32	32.1	0.1	0.30	1.4
31	31.1	0.1	0.30	1.4
30	30.1	0.1	0.30	1.4
29	29.2	0.2	0.30	1.4
28	28.2	0.2	0.30	1.4

Date of Calibration : 8-10 Nov. 2021

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Request No. 21-65/0071

MTC No. EEL. BP. 15/1164

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.0	0.0	0.20	±1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
	200	110.0	0.0	0.20	±1.3
SEL	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 8-10 Nov. 2021

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Request No. 21-65/0071

MTC No. EEL. BP. 15/1164

9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.1	-0.3	0.20	2.4
Positive half cycle	124.4	124.2	-0.2	0.20	1.4
Negative half cycle	124.4	124.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
135.6	135.6	0.0	0.30	1.8

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 8-10 Nov. 2021

Date of Issue : 16 Nov. 2021

Ref : 2011264110504565002

End of Certificate

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FM.BL.MTC.002 Rev.4

**SOUND LEVEL METER**

**MODEL : NL-42**

**SERIAL No. : 01147298**



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0292

MTC No. EEL. BP. 26/0265

CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.  
Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.  
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :		Ambient Environment
Description	: Sound Level Meter	Temperature : (23 ± 3) °C
Manufacturer	: Rion	Relative Humidity : (50 ± 15) %
Model	: NL-42	Ambient Pressure : (101.325 ± 1.5) kPa

Serial No. : 01147298  
Microphone : Type UC-52 No.191028  
Preamplifier : Type NH-24 No.47531

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. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Feb. 2022

Date of Calibration : 3 Mar. 2022

The results relate only to the items tested/calibrated or value assigned.  
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0292

MTC No. EEL. BP. 26/0265

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 (2006). 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 : 3 Mar. 2022

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FM.BLMTC.002 Rev.4

### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	Uncertainty (±dB)	
113.97	Before adjust 114.2	After adjust 114.0	0.0	0.30
			0.0	1.4

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.8 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.8	0.10

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

Frequency	Measured Value (dB)	Uncertainty (±dB)
Weighting		
A-Weighting	11.9	0.10
C-Weighting	17.3	0.10
Flat	22.5	0.10

Date of Calibration : 3 Mar. 2022

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FM.BLMTC.002 Rev.4

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)	
125	-0.3	-0.2	-0.2	0.40
1 000	0.4	0.4	0.4	0.40
4 000	-1.1	-1.0	-1.1	0.40
				2.0
				1.4
				3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)	
63	0.0	-0.1	-0.1	0.20
125	-0.1	0.0	-0.1	0.20
250	0.0	0.0	0.0	0.20
500	0.0	0.0	0.0	0.20
1 000	0.0	0.0	0.0	0.20
2 000	0.1	0.0	-0.1	0.20
4 000	0.0	0.0	-0.1	0.20
8 000	0.1	0.0	-0.1	0.20
				1.9
				2.0
				1.9
				1.4
				2.6
				3.6
				5.6

Date of Calibration : 3 Mar. 2022

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FM.BLMTC.002 Rev.4



5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
137	137.1	0.1	0.30	1.4
136	136.1	0.1	0.30	1.4
135	135.1	0.1	0.30	1.4
134	134.1	0.1	0.30	1.4
133	133.1	0.1	0.30	1.4
132	132.1	0.1	0.30	1.4
131	131.1	0.1	0.30	1.4

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6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
130	130.1	0.1	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
119	119.1	0.1	0.30	1.4
114	114.1	0.1	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.1	0.1	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.1	0.1	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.0	0.0	0.30	1.4
28	28.0	0.0	0.30	1.4

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6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
27	27.0	0.0	0.30	1.4
26	26.0	0.0	0.30	1.4
25	25.0	0.0	0.30	1.4

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
30-130	125	125.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	126.1	0.1	0.20	±1.3
	2	109.0	0.0	0.20	+1.3; -2.8
	0.25	99.9	-0.1	0.20	+1.8; -5.3
Slow	200	119.5	-0.1	0.20	±1.3
	2	100.0	0.0	0.20	+1.3; -5.3
	200	120.0	0.0	0.20	±1.3
SEL	2	100.0	0.0	0.20	+1.3; -2.8
	0.25	90.8	-0.2	0.20	+1.8; -5.3

Date of Calibration : 3 Mar. 2022

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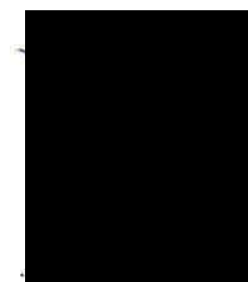
9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.2	-0.2	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)	Deviated value (dB)		Tolerance Limits Class 2 (±dB)
	Positive one-half cycle	Negative one-half cycle	
131.9	131.9	0.0	0.30
			1.8

Calibrated by



Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 201126502020458001

Date of Calibration : 3 Mar. 2022

Date of Issue : 4 Mar. 2022

End of Certificate

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**SOUND LEVEL METER**

**MODEL : NL-21**

**SERIAL No. : 00310456**





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0618

MTC No. EEL. BP. 40/0664

## CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11, Sukhaphibarn 8, Nongkham, Sriracha, Chonburi 20230.

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-21

Serial No. : 00310456

Microphone : Type UC-52 No.153489

Preamplifier : Type NH-21 No.34625

### Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
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 : 8 Jun. 2021

Date of Calibration : 1-2 Jul. 2021

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Date of Calibration : 1-2 Jul. 2021

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
	113.90	114.2			

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)
18.3	0.10

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

Frequency	Measured Value (dB)	Uncertainty (±dB)
Weighting		
A-Weighting	16.0	0.10
C-Weighting	19.0	0.10
Flat	25.1	0.10

Date of Calibration : 1-2 Jul. 2021

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.0	0.2	0.0	0.40	2.0
1000	0.0	-0.1	0.0	0.40	1.4
4000	-0.9	-0.8	-0.9	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	-0.1	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	0.0	0.20	2.0
250	-0.1	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1000	0.0	0.0	0.0	0.20	1.4
2000	0.1	0.1	0.1	0.20	2.6
4000	0.0	0.0	0.1	0.20	3.6
8000	0.2	0.2	0.1	0.20	5.6

Date of Calibration : 1-2 Jul. 2021

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

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Fax. (66) 0 2323 9165

6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	88.9	-0.1	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
33	32.9	-0.1	0.30	1.4
32	31.8	-0.2	0.30	1.4
31	30.9	-0.1	0.30	1.4
30	29.8	-0.2	0.30	1.4
29	28.6	-0.4	0.30	1.4
28	27.6	-0.4	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.0	0.0	0.20	±1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
SEL	200	110.0	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 1-2 Jul. 2021

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E-mail : numpai@tistr.or.th

9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.0	-0.4	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	135.7	0.0	1.8
135.7	135.7			

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264060802448002

End of Certificate

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**SOUND LEVEL METER**

**MODEL : NL-21**

**SERIAL No. : 00209071**

Request No. 21-65/0071

MTC No. EEL. BP. 16/1164

## CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co.,Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi, 20230.

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-21

Serial No. : 00209071 (No.15)

Microphone : Type UC-52 No.186090

Preamplifier : Type NH-21 No.00836

### 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. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 5 Nov. 2021

Date of Calibration : 8-10 Nov. 2021

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Request No. 21-65/0071

MTC No. EEL. BP. 16/1164

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 (2006). 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 : 8-10 Nov. 2021

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
113.90	114.0	113.9	0.0	0.30	1.4

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 111.8 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
18.3	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	16.3	0.10
C-Weighting	25.6	0.10
Flat	31.3	0.10

Date of Calibration : 8-10 Nov. 2021

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.4	0.5	0.4	0.40	2.0
1 000	-0.1	-0.1	0.0	0.40	1.4
4 000	0.4	0.4	0.4	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	-0.1	-0.1	-0.2	0.20	2.5
125	-0.1	0.0	-0.1	0.20	2.0
250	-0.1	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.1	0.1	0.20	2.6
4 000	0.0	0.1	0.1	0.20	3.6
8 000	0.2	0.2	0.1	0.20	5.6

Date of Calibration : 8-10 Nov. 2021

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 8-10 Nov. 2021

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6. Level linearity on the reference level range (con.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
33	33.0	0.0	0.30	1.4
32	31.9	-0.1	0.30	1.4
31	30.9	-0.1	0.30	1.4
30	29.9	-0.1	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	28.0	0.0	0.30	1.4

Date of Calibration : 8-10 Nov. 2021

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.0	0.0	0.20	±1.3
	2	98.9	-0.1	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
	200	110.0	0.0	0.20	±1.3
SEL	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.8	-0.2	0.20	+1.8; -5.3

Date of Calibration : 8-10 Nov. 2021

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.0	-0.4	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle				
135.6	Negative one-half cycle	135.6	0.0	0.30
				1.8

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 8-10 Nov. 2021

Date of Issue : 16 Nov. 2021

Ref : 20112641110504565003

End of Certificate

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**SOUND LEVEL METER**

**MODEL : CR:172A**

**SERIAL No. : G301039**



Request No. 21-65/0292

MTC No. EEL. BP. 27/0265

## CALIBRATION CERTIFICATE

Submitted by : Eastern Thai Consulting 1992 Co., Ltd.

Address : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

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 : Cirrus

Model : CR-172A

Serial No. : G301039

Microphone : Cirrus MK216 No.413374B

Pre-amplifier : No.9548F

## 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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Feb. 2022

Date of Calibration : 3 Mar. 2022

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FMBL.MTC.002 Rev.4



Request No. 21-65/0292

MTC No. EEL. BP. 27/0265

9. Power Amplifier Brüel&amp;Kjær 2706 S/N 1517650.

10. Speaker Tamoy 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 (2006). 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 : 3 Mar. 2022

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value	Deviation	Uncertainty	
93.73	Before adjust 93.6	After adjust 93.7	0.0	0.50
				1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 93.7 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.8	0.10

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

Frequency	Measured Value (dB)	Uncertainty (±dB)
Weighting	under-range	-
A-Weighting	19.8	0.10
C-Weighting	28.8	0.10

Note: The under-range means the indicator cannot display the value because it is under the setting range 20-140

Date of Calibration : 3 Mar. 2022

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)	
125	0.0	0.0	-0.1	0.40
1 000	-0.3	-0.4	-0.4	0.40
4 000	-0.1	0.2	0.4	0.40

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)	
63	0.4	0.1	0.2	0.20
125	0.2	0.1	0.0	0.20
250	0.2	0.0	0.0	0.20
500	0.1	0.0	0.0	0.20
1 000	0.0	0.0	0.0	0.20
2 000	-0.2	-0.1	0.0	0.20
4 000	-0.4	-0.2	-0.1	0.20
8 000	-0.5	-0.3	-0.2	0.20

Date of Calibration : 3 Mar. 2022

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

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6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
139	139.1	0.1	0.30	1.4
134	134.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4

Date of Calibration : 3 Mar. 2022

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	103.9	-0.1	0.30	1.4
99	99.0	0.0	0.30	1.4
94	93.9	-0.1	0.30	1.4
89	88.9	-0.1	0.30	1.4
84	83.8	-0.2	0.30	1.4
79	78.9	-0.1	0.30	1.4
74	73.9	-0.1	0.30	1.4
69	68.9	-0.1	0.30	1.4
64	63.9	-0.1	0.30	1.4
59	58.9	-0.1	0.30	1.4
54	53.8	-0.2	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	43.8	-0.2	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
29	28.9	-0.1	0.30	1.4
24	24.0	0.0	0.30	1.4

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	±1.3
	2	118.9	-0.1	0.20	+1.3; -2.8
	0.25	109.9	-0.1	0.20	+1.8; -5.3
Slow	200	129.6	0.0	0.20	±1.3
	2	110.0	0.0	0.20	+1.3; -5.3
	200	130.0	0.0	0.20	±1.3
SEL	2	110.0	0.0	0.20	+1.3; -2.8
	0.25	100.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 3 Mar. 2022

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Complete cycle	135.4	135.7	0.3	0.20	2.4
Positive half cycle	134.4	134.3	-0.1	0.20	1.4
Negative half cycle	134.4	134.3	-0.1	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	139.1	0.0	0.30	1.8
Negative one-half cycle	139.1	0.0	0.30	1.8

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 3 Mar. 2022

Date of Issue : 4 Mar. 2022

Ref : 2011265020200458002

End of Certificate

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**SOUND LEVEL METER**

**MODEL : NL-21**

**SERIAL No. : 01209912**

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

**Request No.** 21-65/0018

**MTC No.** EEL. BP. 22/1064

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.

**Address** : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.

**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-21  
**Serial No.** : 01209912 (No.18)  
**Microphone** : Type UC-52 No.157154  
**Preamplifier** : Type NH-19 No.54250

### Ambient Environment

**Temperature** :  $(23 \pm 3) ^\circ\text{C}$   
**Relative Humidity** :  $(50 \pm 15) \%$   
**Ambient Pressure** :  $(101.325 \pm 1.5) \text{ kPa}$

### 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** : 11 Oct. 2021

**Date of Calibration** : 20-27 Oct. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

**Request No.** 21-65/0018

**MTC No.** EEL. BP. 22/1064

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 (2006). 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** : 20-27 Oct. 2021

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Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test		Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	
113.94	Before adjust 114.4	After adjust 113.9	0.0
			0.30
			1.4

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 117.8 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.8	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	15.9	0.10
C-Weighting	22.7	0.10
Flat	27.5	0.10

Date of Calibration : 20-27 Oct. 2021

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Request No. 21-65/0018

MTC No. EEL. BP. 22/1064

### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.1	0.2	0.1	2.0
1 000	-0.4	-0.3	-0.3	1.4
4 000	0.8	0.7	0.7	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
63	0.0	-0.1	-0.1	2.5
125	-0.1	0.0	0.0	2.0
250	0.0	-0.1	-0.1	1.9
500	0.0	0.0	0.0	1.9
1 000	0.0	0.0	0.0	1.4
2 000	0.1	0.1	0.1	2.6
4 000	0.0	0.1	0.1	3.6
8 000	0.2	0.2	0.1	5.6

Date of Calibration : 20-27 Oct. 2021

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

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6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
125	125.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
123	123.0	0.0	0.30	1.4
122	122.0	0.0	0.30	1.4
121	121.0	0.0	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 20-27 Oct. 2021

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6. Level linearity on the reference level range (continue)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.1	0.1	0.30	1.4
69	69.1	0.1	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.1	0.1	0.30	1.4
54	54.0	0.0	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.1	0.1	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
33	33.0	0.0	0.30	1.4
32	31.9	-0.1	0.30	1.4
31	31.0	0.0	0.30	1.4
30	30.0	0.0	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	27.9	-0.1	0.30	1.4

Date of Calibration : 20-27 Oct. 2021

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### 7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.1	0.1	0.30	1.4

### 8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	116.1	0.1	0.20	±1.3
	2	99.0	0.0	0.20	+1.3; -2.8
	0.25	89.9	-0.1	0.20	+1.8; -5.3
Slow	200	109.6	0.0	0.20	±1.3
	2	90.0	0.0	0.20	+1.3; -5.3
	200	110.0	0.0	0.20	±1.3
SEL	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 20-27 Oct. 2021

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E-mail : mtc@tistr.or.th

### 9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.0	-0.4	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

### 10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.3
135.6	135.6			

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 20-27 Oct. 2021

Date of Issue : 28 Oct. 2021

Ref : 2011264101104187001

End of Certificate

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**SOUND LEVEL METER**

**MODEL : CR:172A**

**SERIAL No. : G301638**

Request No. 21-65/0292

MTC No. EEL. BP. 28/0265

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.  
**Address** : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.  
**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	Ambient Environment
Sound Level Meter	Temperature : (23 ± 3) °C
Cirrus	Relative Humidity : (50 ± 15) %
CR:172A	Ambient Pressure : (101.325±1.5) kPa

Serial No. : G301638

Microphone : Cirrus MK216 No.412753E

Pre-amplifier : No.10402F

**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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Feb. 2022

Date of Calibration : 1 Mar. 2022

The results relate only to the items tested/calibrated or value assigned.  
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FM.BL.MTC.002 Rev.4

Request No. 21-65/0292

MTC No. EEL. BP. 28/0265

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 (2006). 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 : 1 Mar. 2022

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FM.BL.MTC.002 Rev.4

### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
	93.6	93.7			
93.72					1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 93.7 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
17.3	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	18.2	0.10
C-Weighting	25.0	0.10
Flat	31.0	0.10

Date of Calibration : 1 Mar. 2022

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.0	-0.2	-0.2	0.40	2.0
1 000	-0.5	-0.5	-0.5	0.40	1.4
4 000	0.0	0.1	0.3	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.7	0.1	0.2	0.20	2.5
125	0.3	0.2	0.1	0.20	2.0
250	0.2	0.1	0.0	0.20	1.9
500	0.2	0.1	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.1	0.0	0.0	0.20	2.6
4 000	0.0	-0.2	0.0	0.20	3.6
8 000	-0.2	-0.3	0.0	0.20	5.6

Date of Calibration : 1 Mar. 2022

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## 5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz				
Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

## 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

## 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
139	139.1	0.1	0.30	1.4
134	134.1	0.1	0.30	1.4
129	129.1	0.1	0.30	1.4
124	124.1	0.1	0.30	1.4

Date of Calibration : 1 Mar. 2022

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## 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
119	119.1	0.1	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.1	0.1	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.1	0.1	0.30	1.4
84	84.0	0.0	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	63.9	-0.1	0.30	1.4
59	59.0	0.0	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.0	0.0	0.30	1.4
24	24.2	0.2	0.30	1.4

Date of Calibration : 1 Mar. 2022

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	±1.3
	2	118.8	-0.2	0.20	+1.3; -2.8
	0.25	109.8	-0.2	0.20	+1.8; -5.3
Slow	200	129.5	-0.1	0.20	±1.3
	2	109.9	-0.1	0.20	+1.3; -5.3
	200	130.0	0.0	0.20	±1.3
SEL	2	110.0	0.0	0.20	+1.3; -2.8
	0.25	100.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 1 Mar. 2022

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	135.4	135.7	0.3	0.20	2.4
Positive half cycle	134.4	134.3	-0.1	0.20	1.4
Negative half cycle	134.4	134.3	-0.1	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
139.1	139.1			

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 1 Mar. 2022

Date of Issue : 3 Mar. 2022

Ref : 20112650200458003

End of Certificate

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FM.BLMTC.002 Rev.4

**SOUND LEVEL METER**

**MODEL : CR:172A**

**SERIAL No. : G300957**

Request No. 21-65/0101

MTC No. EEL. BP. 62/1164

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.  
**Address** : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.  
**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	<b>Ambient Environment</b>	Temperature	: (23 ± 3) °C
Manufacturer	: Cirrus	Relative Humidity	: (50 ± 15) %	
Model	: CR-172A	Ambient Pressure	: (101.325 ± 1.5) kPa	
Serial No.	: G300957 (No.28)			

**Microphone** : Cirrus MK216 No.412415B  
**Pre-amplifier** : No.9371F

### 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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2995571.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Date of Receipt** : 17 Nov. 2021

**Date of Calibration** : 13-14 Dec. 2021

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Request No. 21-65/0101

MTC No. EEL. BP. 62/1164

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 (2006). 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** : 13-14 Dec. 2021

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FM.BLMTC.002 Rev.4

### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
	93.75	95.1			

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 93.7 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.4	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	under-range	-
C-Weighting	20.0	0.10
Flat	29.5	0.10

Note: The under-range means the indicator cannot display the value because it is under the setting range 20-140 dB.

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.1	0.0	-0.2	0.40	2.0
1 000	-0.6	-0.6	-0.6	0.40	1.4
4 000	0.2	0.4	0.3	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.4	0.2	0.2	0.20	2.5
125	0.3	0.1	0.1	0.20	2.0
250	0.2	0.1	0.1	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.2	0.0	0.0	0.20	2.6
4 000	-0.3	-0.1	0.0	0.20	3.6
8 000	-0.5	-0.3	-0.1	0.20	5.6

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### 5. Frequency and time weightings at 1 kHz

#### 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

#### 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

### 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
139	139.0	0.0	0.30	1.4
134	134.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4

Date of Calibration : 13-14 Dec. 2021

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### 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.1	0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.1	0.1	0.30	1.4
24	24.1	0.1	0.30	1.4

Date of Calibration : 13-14 Dec. 2021

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	±1.3
	2	118.9	-0.1	0.20	+1.3; -2.8
	0.25	109.9	-0.1	0.20	+1.8; -5.3
Slow	200	129.6	0.0	0.20	±1.3
	2	110.0	0.0	0.20	+1.3; -5.3
	0.25	129.6	-0.4	0.20	±1.3
SEL	200	110.0	0.0	0.20	+1.3; -2.8
	2	110.0	0.0	0.20	+1.3; -2.8
	0.25	100.9	-0.1	0.20	+1.8; -5.3

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	135.4	135.6	0.2	0.20	2.4
Positive half cycle	134.4	134.2	-0.2	0.20	1.4
Negative half cycle	134.4	134.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	139.2	0.1	0.30	1.8
Negative one-half cycle	139.1			

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 201126411704770004

Date of Calibration : 13-14 Dec. 2021

Date of Issue : 15 Dec. 2021

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**SOUND LEVEL METER**

**MODEL : CR:172A**

**SERIAL No. : G301635**



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0818

MTC No. EEL. BP. 13/0964

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.

**Address** : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sitracha, Chonburi 20230.

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

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

### Instrument Calibrated :

<b>Description</b>	<b>Ambient Environment</b>
: Sound Level Meter	: (23 ± 3) °C
: Cirrus	: (50 ± 15) %
<b>Model</b>	: Ambient Pressure
: CR-172A	: (101.325±1.5) kPa

**Serial No.** : G301635 (No.32)

**Microphone** : Cirrus MK216 No.412753F

**Preamplifier** : No.10402F

### 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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Date of Receipt** : 2 Sep. 2021

**Date of Calibration** : 20-22 Sep. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0818

MTC No. EEL. BP. 13/0964

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 (2006). 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** : 20-22 Sep. 2021

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test		Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	
94.06	93.9	-0.2	0.50 1.4

Note: The internal calibration display at 93.7 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
17.3	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	under-range	-
C-Weighting	20.1	0.10
Flat	31.1	0.10

Note: The under-range means the indicator cannot display the value because it is under the setting range 20-140 dB.

Date of Calibration : 20-22 Sep. 2021

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.1	-0.1	-0.1	0.40	2.0
1 000	-0.4	-0.4	-0.4	0.40	1.4
4 000	0.7	0.8	1.0	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.3	0.1	0.1	0.20	2.5
125	0.3	0.1	0.0	0.20	2.0
250	0.2	0.0	0.0	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.2	-0.1	0.0	0.20	2.6
4 000	-0.3	-0.2	0.0	0.20	3.6
8 000	-0.5	-0.4	-0.1	0.20	5.6

Date of Calibration : 20-22 Sep. 2021

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## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

## 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

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## 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
139	139.1	0.1	0.30	1.4
134	134.1	0.1	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4

Date of Calibration : 20-22 Sep. 2021

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## 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	43.9	-0.1	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.1	0.1	0.30	1.4
24	24.2	0.2	0.30	1.4

Date of Calibration : 20-22 Sep. 2021

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (dB)	Tolerance Limits Class 2 (dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	$\pm 1.3$ +1.3; -2.8
	2	118.9	-0.1	0.20	
	0.25	109.9	-0.1	0.20	
Slow	200	129.5	-0.1	0.20	$\pm 1.3$ +1.3; -5.3
	2	110.0	0.0	0.20	
	0.25	100.9	-0.1	0.20	
SEL	200	130.0	0.0	0.20	$\pm 1.3$ +1.3; -2.8
	2	110.0	0.0	0.20	
	0.25	100.9	-0.1	0.20	

Date of Calibration : 20-22 Sep. 2021

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limits Class 2 (dB)
Complete cycle	135.4	135.6	0.2	0.20	2.4
Positive half cycle	134.4	134.2	-0.2	0.20	1.4
Negative half cycle	134.4	134.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (dB)	Tolerance Limits Class 2 (dB)
Positive one-half cycle	Negative one-half cycle	-0.1	0.30	1.8
139.1	139.2			

Calibrated by:

Approved by:



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 20-22 Sep. 2021

Date of Issue : 4 Oct. 2021

Ref: 2011264090203654002

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End of Certificate

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**SOUND LEVEL METER**

**MODEL : CR:172A**

**SERIAL No. : G301660**

Request No. 21-64/0818

MTC No. EEL. BP. 14/0964

## CALIBRATION CERTIFICATE

**Submitted by** : Eastern Thai Consulting 1992 Co., Ltd.  
**Address** : 683 Moo 11 Sukaphibal 8 Rd., Nongkham, Sriracha, Chonburi 20230.  
**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	Temperature	(23 ± 3) °C
Manufacturer	Cirrus	Relative Humidity	(50 ± 15) %
Model	CR:172A	Ambient Pressure	(101.325 ± 1.5) kPa

Serial No. : G301660 (No.34)

Microphone : Cirrus MK216 No.412814E

Preamplifier : No.10093F

### 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. Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 2 Sep. 2021

Date of Calibration : 20-22 Sep. 2021

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Request No. 21-64/0818

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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 (2006). 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 : 20-22 Sep. 2021

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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	Uncertainty (±dB)	
94.06	94.2	0.1	0.50	1.4

Note: The internal calibration display at 93.7 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.5	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	under-range	-
C-Weighting	18.9	0.10
Flat	29.1	0.10

Note: The under-range means the indicator cannot display the value because it is under the setting range 20-140 dB.

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.2	0.0	-0.1	0.40	2.0
1 000	0.2	0.2	0.2	0.40	1.4
4 000	-0.2	0.0	0.2	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.3	0.0	0.1	0.20	2.5
125	0.2	0.1	0.0	0.20	2.0
250	0.1	0.0	0.0	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	-0.1	0.0	0.20	2.6
4 000	-0.4	-0.3	-0.1	0.20	3.6
8 000	-0.6	-0.4	-0.1	0.20	5.6

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## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	114.0	0.0	0.20	0.4
C-weighting	114.0	0.0	0.20	0.4
Flat	114.0	0.0	0.20	0.4

## 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	114.0	0.0	0.20	0.3
Slow	114.0	0.0	0.20	0.3
Leq	114.0	0.0	0.20	0.3

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## 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
139	139.1	0.1	0.30	1.4
134	134.1	0.1	0.30	1.4
129	129.1	0.1	0.30	1.4
124	124.1	0.1	0.30	1.4

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## 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.0	0.0	0.30	1.4
24	24.2	0.2	0.30	1.4

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-140	135	135.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	136.0	0.0	0.20	±1.3
	2	119.0	0.0	0.20	+1.3; -2.8
	0.25	109.9	-0.1	0.20	+1.8; -5.3
Slow	200	129.6	0.0	0.20	±1.3
	2	110.0	0.0	0.20	+1.3; -5.3
	200	130.0	0.0	0.20	±1.3
SEL	2	110.0	0.0	0.20	+1.3; -2.8
	0.25	100.9	-0.1	0.20	+1.8; -5.3

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	135.4	135.6	0.2	0.20	2.4
Positive half cycle	134.4	134.2	-0.2	0.20	1.4
Negative half cycle	134.4	134.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.9	0.30	1.8
139.1	139.1			

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 201204-0902636-5003

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