

ภาคผนวก ง

ใบรับรองเอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / หมายเหตุ

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|--------------|------------------------------|---|------------|-----------------|-----------|--------------------------|
| Ambient | Particulate Matter (PM-10) | High Volume | RYG-F50183 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG-F50184 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG-F50839 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG-F50400 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-2.5) | Digital Balance | RYG-F50001 | 14-Jan-23 | 14-Jan-24 | 12 |
| Ambient | Total Suspended Particulate | High Volume | RYG-F50179 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG-F50175 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG-F50174 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG-F50173 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | Digital Balance | RYG-F50001 | 14-Jan-23 | 14-Jan-24 | 12 |
| Ambient | Sulfur Dioxide | SO ₂ Analyzer | RYG-F50432 | 4-Jan-23 | 4-Jul-23 | 6 |
| Ambient | Sulfur Dioxide | SO ₂ Analyzer | RYG-F50438 | 4-Jan-23 | 4-Jul-23 | 6 |
| Ambient | Sulfur Dioxide | SO ₂ Analyzer | RYG-F50234 | 4-Jan-23 | 4-Jul-23 | 6 |
| Ambient | Sulfur Dioxide | SO ₂ Analyzer | RYG-F50432 | 4-Jan-23 | 4-Jul-23 | 6 |
| Ambient | Nitrogen Dioxide | NO ₂ Analyzer | RYG-F50433 | 3-Jan-23 | 3-Jul-23 | 6 |
| Ambient | Nitrogen Dioxide | NO ₂ Analyzer | RYG-F50435 | 3-Jan-23 | 3-Jul-23 | 6 |
| Ambient | Nitrogen Dioxide | NO ₂ Analyzer | RYG-F50235 | 3-Jan-23 | 3-Jul-23 | 6 |
| Ambient | Nitrogen Dioxide | NO ₂ Analyzer | RYG-F50435 | 3-Jan-23 | 3-Jul-23 | 6 |
| Ambient | Wind Speed / Wind Direction | Wind Speed / Wind Direction | RYG-F50087 | 15-Jan-23 | 15-Jan-24 | 18 |
| Ambient | Wind Speed / Wind Direction | Wind Speed / Wind Direction | RYG-F50055 | 20-Dec-22 | 18-Jan-24 | 18 |
| Ambient | Wind Speed / Wind Direction | Wind Speed / Wind Direction | RYG-F50043 | 3-Jan-23 | 3-Jul-23 | 18 |
| Ambient | Wind Speed / Wind Direction | Wind Speed / Wind Direction | RYG-F50089 | 15-Jan-23 | 15-Jan-24 | 18 |
| Stack | Total Suspended Particulate | Comstar Control Unit | RYG-F50536 | 3-Jan-23 | 3-Jul-23 | 6 |
| Stack | Total Suspended Particulate | Digital Balance | RYG-F50003 | 14-Jan-23 | 14-Jan-24 | 12 |
| Stack (CEMS) | Carbon Monoxide | Analyzer - System calibration, Standard gas | - | - | - | - |
| Stack (CEMS) | Oxides of Nitrogen | Analyzer - System calibration, Standard gas | - | - | - | - |
| Stack (CEMS) | Sulfur Dioxide | Analyzer - System calibration, Standard gas | - | - | - | - |
| Stack (CEMS) | Oxygen | Analyzer - System calibration, Standard gas | - | - | - | - |
| Noise | Leq 24 Hrs | Sound Calibrator | RYG-F50215 | 31-Aug-22 | 31-Aug-23 | 12 |
| Noise | Leq 24 Hrs | Sound Level Meter | RYG-F50426 | 25-Jan-23 | 25-Jan-24 | 12 |
| Noise | Leq 24 Hrs | Sound Level Meter | RYG-F50027 | 13-Jan-23 | 13-Jan-24 | 12 |
| Noise | Leq 24 Hrs | Sound Level Meter | RYG-F50029 | 24-May-22 | 24-May-23 | 12 |
| Noise | Leq 24 Hrs | Sound Level Meter | RYG-F50023 | 13-Jan-23 | 13-Jan-24 | 12 |
| Noise | Leq 24 Hrs | Sound Level Meter | RYG-F50025 | 25-Jan-23 | 25-Jan-24 | 12 |
| Noise | Leq 24 Hrs | Sound Level Meter | RYG-F50024 | 16-Dec-22 | 16-Dec-23 | 12 |
| Noise | Leq 8 Hrs | Sound Calibrator | RYG-F50496 | 17-Jan-23 | 17-Jan-24 | 12 |
| Noise | Leq 8 Hrs | Sound Level Meter | RYG-F50017 | 20-Dec-22 | 20-Dec-23 | 12 |
| Noise | Leq 8 Hrs | Sound Calibrator | RYG-F50215 | 31-Aug-22 | 31-Aug-23 | 12 |
| Noise | Leq 8 Hrs | Sound Level Meter | RYG-F50492 | 13-Jan-23 | 13-Jan-24 | 12 |
| Heat | Heat Stress | Heat Stress Monitor | RYG-F50157 | 02-Feb-23 | 24-Feb-24 | 12 |
| Heat | Heat Stress | Heat Stress Monitor | RYG-F50228 | 14-Feb-23 | 14-Feb-24 | 12 |
| Rayong Lab | pH | pH-E6 Meter | RYG-F50152 | 22-Dec-22 | 22-Dec-23 | 12 |
| Rayong Lab | pH | pH Meter | RYG-F50152 | 22-Dec-22 | 22-Dec-23 | 12 |
| Rayong Lab | Color for Cr(VI) | Spectrophotometer | RYG-F50037 | 27-Sep-22 | 27-Sep-24 | 18 |
| Rayong Lab | Color for Cr(VI) | Spectrophotometer | RYG-F50037 | 27-Sep-22 | 27-Sep-24 | 18 |
| Rayong Lab | DO | DO meter with Sensor | RYG-F50052 | 18-Feb-22 | 12-Aug-23 | 18 |
| Rayong Lab | DO | DO meter with Sensor | RYG-F50154 | 22-Apr-22 | 21-Oct-23 | 18 |
| Rayong Lab | DO | Spectrophotometer | RYG-F50037 | 27-Sep-22 | 27-Sep-24 | 18 |
| Rayong Lab | Total Suspended Solids | Electronic Balance | RYG-F50002 | 14-Jan-23 | 14-Jan-24 | 12 |
| Rayong Lab | Total Suspended Solids | Hot Air Oven | RYG-F50010 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Total Dissolved Solids (TDS) | Electronic Balance | RYG-F50002 | 14-Jan-23 | 14-Jan-24 | 12 |
| Rayong Lab | Total Dissolved Solids (TDS) | Hot Air Oven | RYG-F50010 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Oil & Grease | Electronic Balance | RYG-F50002 | 14-Jan-23 | 14-Jan-24 | 12 |
| Rayong Lab | Oil & Grease | Hot Air Oven | RYG-F50010 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Oil & Grease | Water Bath | RYG-F50061 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Temperature | Digital Thermometer With Sensor | RYG-F50542 | 31-Aug-22 | 31-Aug-23 | 12 |

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / หมายเหตุ

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|-------------|-------------|----------------|------------|-----------------|-----------|--------------------------|
| Rayong Lab | Temperature | pH meter | RYG-F50219 | 22-Jul-22 | 22-Jul-23 | 12 |
| Rayong Lab | Temperature | pH meter | RYG-F50549 | 18-Aug-22 | 18-Aug-23 | 12 |
| Rayong Lab | Temperature | pH meter | RYG-F50894 | 7-Sep-22 | 7-Sep-23 | 12 |
| Rayong Lab | Temperature | pH meter | RYG-F50852 | 7-Sep-22 | 7-Sep-23 | 12 |

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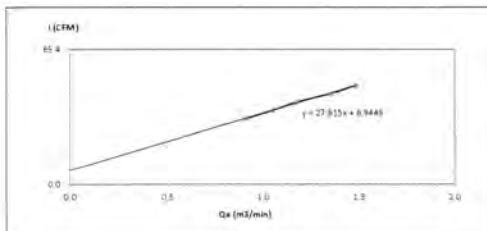
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High Volume Air Sampler Calibration Worksheet

| | | | |
|------------------------|------------------------------------|------------------------------|------------|
| Project Site: | GLOW ENERGY PUBLIC COMPANY LIMITED | Barometric Pressure (mm Hg): | 758 |
| Calibrate Location: | พื้นที่ก่อสร้างโรงงานพลังงาน (A1) | Temperature (°C): | 32 |
| Calibrate Date: | 18-Apr-23 | High Volume ID: | RYG-F50105 |
| Calibration Sheet No.: | C-180423-RYG-F50105 | High Volume Model: | TE-5009X |
| Calibrator ID: | RYG-F50205 | High Volume S/N: | 4793 |
| Calibrator Model: | TE-5020A | Calibrator Slope: | 0.9444 |
| Calibrator S/N: | 1166 | Calibrator Intercept: | -0.01292 |

| Test No. | Delta H ₂ O (Inch) | Q _a (m ³ /min) | 1: Chart (CFM) | Linear Regression |
|----------|-------------------------------|--------------------------------------|----------------|---------------------------------|
| 1 | 1.8 | 0.914 | 32 | Slope: 27.6151 |
| 2 | 2.4 | 1.054 | 36 | Intercept: 0.9449 |
| 3 | 3.0 | 1.170 | 40 | Correlation Coefficient: 0.9994 |
| 4 | 4.0 | 1.356 | 44 | |
| 5 | 4.8 | 1.495 | 48 | |



Calibrated by: Kantaphon M.
(Mr. Kantaphon Maneevongman)
Field Scientist (2)

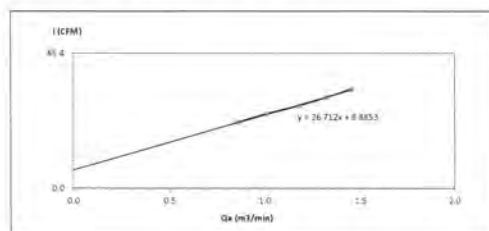
Approved by: [Signature]
(Mr. Noppung Juntarupun)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

| | | | |
|------------------------|------------------------------------|------------------------------|------------|
| Project Site: | GLOW ENERGY PUBLIC COMPANY LIMITED | Barometric Pressure (mm Hg): | 758 |
| Calibrate Location: | พื้นที่ก่อสร้างโรงงานพลังงาน (A2) | Temperature (°C): | 32 |
| Calibrate Date: | 18-Apr-23 | High Volume ID: | RYG-F50104 |
| Calibration Sheet No.: | C-180423-RYG-F50104 | High Volume Model: | TE-5009X |
| Calibrator ID: | RYG-F50205 | High Volume S/N: | 4792 |
| Calibrator Model: | TE-5020A | Calibrator Slope: | 0.84438 |
| Calibrator S/N: | 1166 | Calibrator Intercept: | -0.01292 |

| Test No. | Delta H ₂ O (Inch) | Q _a (m ³ /min) | 1: Chart (CFM) | Linear Regression |
|----------|-------------------------------|--------------------------------------|----------------|---------------------------------|
| 1 | 1.6 | 0.868 | 32 | Slope: 26.7119 |
| 2 | 2.2 | 1.009 | 36 | Intercept: 0.8853 |
| 3 | 3.8 | 1.376 | 40 | Correlation Coefficient: 0.9992 |
| 4 | 3.0 | 1.322 | 44 | |
| 5 | 4.6 | 1.454 | 48 | |



Calibrated by: Kantaphon M.
(Mr. Kantaphon Maneevongman)
Field Scientist (2)

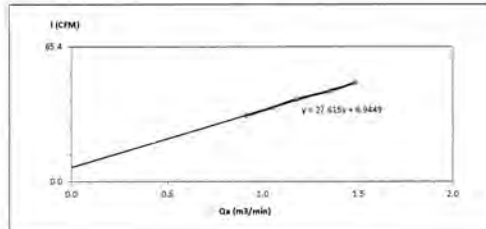
Approved by: [Signature]
(Mr. Noppung Juntarupun)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : GLOW ENERGY PUBLIC COMPANY LIMITED
 Calibrate Location : (สถานที่สอบเทียบ) (AS)
 Calibrate Date : 18-Apr-23
 Calibration Sheet No. : C-180423-RYG-FS0399
 Calibrator ID : RYG-FS0205
 Calibrator Model : TE-5028A
 Calibrator S/N : 1166
 Barometric Pressure (mm Hg) : 758
 Temperature (°C) : 32
 High Volume ID : RYG-FS0399
 High Volume Model : TE-5009X
 High Volume S/N : 5683
 Calibrator Slope : 0.94434
 Calibrator Intercept : -0.01292

| Test No. | Delta H ₂ O (inch) | Q _a (m ³ /min) | I Chart (CFM) | Linear Regression |
|----------|-------------------------------|--------------------------------------|---------------|---|
| 1 | 1.8 | 0.914 | 32 | Slope : 27.6151 Intercept : 6.9449 Correlation Coefficient : 0.9984 |
| 2 | 2.4 | 1.054 | 36 | |
| 3 | 3.0 | 1.176 | 40 | |
| 4 | 4.0 | 1.356 | 44 | |
| 5 | 4.8 | 1.485 | 48 | |



Calibrated by : Kantaphon M.
 (Mr. Kantaphon Maneeasampan)
 Field Scientist(2)

Approved by : [Signature]
 (Mr. Noppung Jantaraporn)
 Entire Field Coordinator Scientist (3)

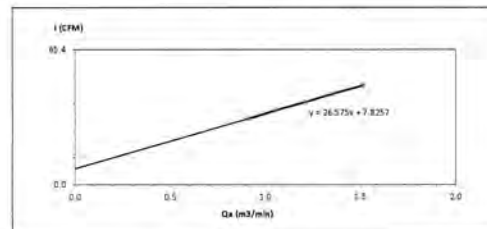
FORM RH.1 (R-074) REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : GLOW ENERGY PUBLIC COMPANY LIMITED
 Calibrate Location : (สถานที่สอบเทียบ) (AS)
 Calibrate Date : 18-Apr-23
 Calibration Sheet No. : C-180423-RYG-FS0400
 Calibrator ID : RYG-FS0205
 Calibrator Model : TE-5028A
 Calibrator S/N : 1166
 Barometric Pressure (mm Hg) : 758
 Temperature (°C) : 32
 High Volume ID : RYG-FS0400
 High Volume Model : TE-5009X
 High Volume S/N : 5691
 Calibrator Slope : 0.94434
 Calibrator Intercept : -0.01292

| Test No. | Delta H ₂ O (inch) | Q _a (m ³ /min) | I Chart (CFM) | Linear Regression |
|----------|-------------------------------|--------------------------------------|---------------|---|
| 1 | 1.8 | 0.914 | 32 | Slope : 26.5751 Intercept : 7.8257 Correlation Coefficient : 0.9999 |
| 2 | 2.4 | 1.054 | 36 | |
| 3 | 3.2 | 1.215 | 40 | |
| 4 | 4.8 | 1.356 | 44 | |
| 5 | 5.0 | 1.515 | 48 | |



Calibrated by : Kantaphon M.
 (Mr. Kantaphon Maneeasampan)
 Field Scientist(2)

Approved by : [Signature]
 (Mr. Noppung Jantaraporn)
 Entire Field Coordinator Scientist (3)

FORM RH.1 (R-074) REVISION NO.: ISSUE DATE: 14/03/16

RYG_EN0001

Sartorius (Thailand) Co., Ltd.
 129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
 Tel : +66 2643 6381-6, e-mail : service.thailand@sartorius.com



SARTORIUS
 UKAS-TS15 17025
 CALIBRATION 0426

Certificate of Calibration

Model Number : LA130S-F
 Description : Analytical Balance
 Serial Number : 25409664
 ID No. : RYG_EN0001
 Manufacturer : Sartorius
 Certificate No. : 23BC0110
 Issued Date : Friday, March 03, 2023
 Reference No. : 204833
 Page No. : 1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
 616/10 Moo 5 T.Maenam Khu. A.Pluak Daeng, Rayong 21140, Thailand

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
 616/10 Moo 5 T.Maenam Khu. A.Pluak Daeng, Rayong 21140, Thailand

Calibrated By : Mr. Chonchai Inthana
 Calibration Date : Wednesday, March 01, 2023
 Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14 : 2019

Metrological data :
 Capacity : 150 g Readability : 0.0001 g
 Ambient Conditions :
 Temperature : 24.2 °C ± 5.0 °C
 Humidity : 60.0 % RH ± 10.0 % RH
 Pressure : ± 10.0 % RH
 Reasons for calibration :
☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance
 Equipment Condition : ☒ Good Overdue ☐ Fail

Measurement Method : UKAS Publication Ref : Lab 14
 The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

| Model Number | Description | Traceability | Certificate No. | Due Date |
|---------------|---|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2 YCS011-522-00 | SPC-RT | C02212565 | 14-Sep-2023 |
| MHB-382SD | Humidity/Barometer/Temp. Lutron MHB-382SD | DKSH | C19220444 | 5-Sep-2023 |

This certificate relate and apply this equipment only.
 This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division.
 Sartorius (Thailand) Co., Ltd.

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
 129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
 Tel : +66 2643 6381-6 Fax : +66 2643 6387, e-mail : service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : LA130S-F
 Description : Analytical Balance
 Serial Number : 25409664
 ID No. : RYG_EN0001
 Manufacturer : Sartorius
 Certificate No. : 23BC0110
 Issued Date : Friday, March 03, 2023
 Reference No. : 204833
 Page No. : 2 of 2

Calibration Results : Without Adjustment

| Repeatability | Eccentricity (Off-center loading error) |
|---|--|
| The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively. | The off-center loading error is yielded by the difference between the reading of the load (i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points) (positions defined according to OIML R110). |
| Nominal Value (Low Load) 10 g Tolerance 0.0001 g | Nominal value : 50 g Tolerance : 0.0004 g |
| Nominal Value (High Load) 100 g Tolerance 0.0001 g | Difference 1 2 3 4 5 6 |
| Standard Deviation : 0.00009 0.00006 | |

Linearity

The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

| Tolerance | 0.0002 g | | | |
|---------------|-------------------------|-----------------|-----------|-------------|
| Nominal Value | Conventional Mass Value | Displayed Value | Deviation | Uncertainty |
| (g) | (g) | (g) | (g) | (g) |
| 0.01 | 0.0100 | 0.0100 | 0.0000 | 0.00022 |
| 0.05 | 0.0500 | 0.0500 | 0.0000 | 0.00023 |
| 0.1 | 0.1000 | 0.1000 | 0.0000 | 0.00023 |
| 0.5 | 0.5000 | 0.5000 | 0.0000 | 0.00023 |
| 1 | 1.0000 | 1.0000 | 0.0000 | 0.00023 |
| 2 | 2.0000 | 2.0000 | 0.0000 | 0.00023 |
| 5 | 5.0000 | 5.0000 | 0.0000 | 0.00022 |
| 10 | 10.0000 | 10.0000 | 0.0001 | 0.00024 |
| 20 | 20.0000 | 20.0001 | 0.0001 | 0.00023 |
| 100 | 100.0000 | 100.0002 | 0.0002 | 0.00026 |

End of Report

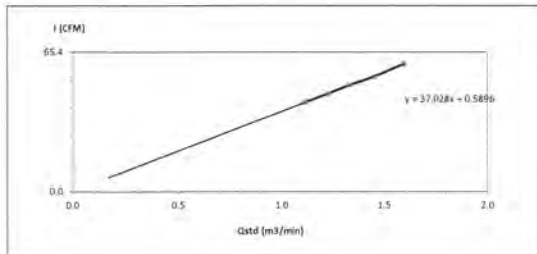
SOP FM 33 03 February 2022



High Volume Air Sampler Calibration Worksheet

Project Site: GLOW ENERGY PUBLIC COMPANY LIMITED
Calibrate Location: โรงไฟฟ้าพลังงานแสงอาทิตย์ (A1)
Calibrate Date: 18-Apr-23
Calibration Sheet No.: C-180423-RYG_FS0179
Calibrator ID: RYG_FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 32
High Volume ID: RYG_FS0179
High Volume Model: TE-5170D
High Volume S/N: 4805
Calibrator Slope: 1.50765
Calibrator Intercept: -0.02043

| Test No. | Delta H ₂ O (inch) | Q _{std} (m ³ /min) | I: Chart (CFM) | Linear Regression |
|----------|-------------------------------|--|----------------|--|
| 1 | 3.8 | 1.1161 | 42 | Slope: 37.0283 Intercept: 0.5896 Correlation Coefficient: 0.9992 |
| 2 | 3.4 | 1.2277 | 46 | |
| 3 | 4.0 | 1.3300 | 50 | |
| 4 | 4.8 | 1.4549 | 54 | |
| 5 | 5.8 | 1.5973 | 60 | |



Calibrated by: Kantaphon M.
(Mr. Kantaphon Maneeesampan)
Field Scientist(2)

Approved by: (Signature)
(Mr. Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

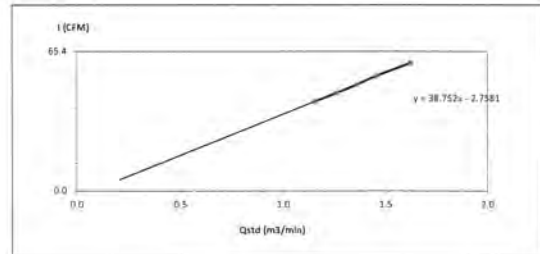
FORM NO.: E 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: GLOW ENERGY PUBLIC COMPANY LIMITED
Calibrate Location: โรงไฟฟ้าพลังงานแสงอาทิตย์ (A2)
Calibrate Date: 18-Apr-23
Calibration Sheet No.: C-180423-RYG_FS0175
Calibrator ID: RYG_FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 32
High Volume ID: RYG_FS0175
High Volume Model: TE-5170D
High Volume S/N: 4801
Calibrator Slope: 1.50765
Calibrator Intercept: -0.02043

| Test No. | Delta H ₂ O (inch) | Q _{std} (m ³ /min) | I: Chart (CFM) | Linear Regression |
|----------|-------------------------------|--|----------------|---|
| 1 | 3.0 | 1.1545 | 42 | Slope: 38.7520 Intercept: -2.7581 Correlation Coefficient: 0.9995 |
| 2 | 3.6 | 1.2628 | 46 | |
| 3 | 4.2 | 1.3623 | 50 | |
| 4 | 4.8 | 1.4549 | 54 | |
| 5 | 5.0 | 1.6243 | 60 | |



Calibrated by: Kantaphon M.
(Mr. Kantaphon Maneeesampan)
Field Scientist(2)

Approved by: (Signature)
(Mr. Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

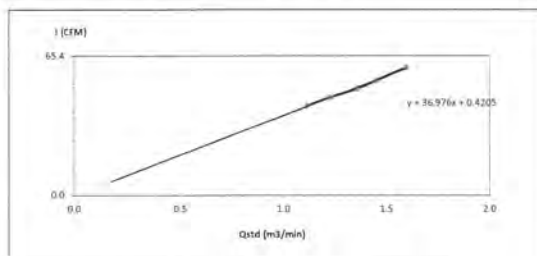
FORM NO.: E 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: GLOW ENERGY PUBLIC COMPANY LIMITED
Calibrate Location: โรงไฟฟ้าพลังงานแสงอาทิตย์ (A3)
Calibrate Date: 18-Apr-23
Calibration Sheet No.: C-180423-RYG_FS0174
Calibrator ID: RYG_FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 32
High Volume ID: RYG_FS0174
High Volume Model: TE-5170D
High Volume S/N: 4800
Calibrator Slope: 1.50765
Calibrator Intercept: -0.02043

| Test No. | Delta H ₂ O (inch) | Q _{std} (m ³ /min) | I: Chart (CFM) | Linear Regression |
|----------|-------------------------------|--|----------------|--|
| 1 | 2.8 | 1.1161 | 42 | Slope: 36.9762 Intercept: 0.4205 Correlation Coefficient: 0.9992 |
| 2 | 3.4 | 1.2277 | 46 | |
| 3 | 4.2 | 1.3623 | 50 | |
| 4 | 4.8 | 1.4549 | 54 | |
| 5 | 5.8 | 1.5973 | 60 | |



Calibrated by: Kantaphon M.
(Mr. Kantaphon Maneeesampan)
Field Scientist(2)

Approved by: (Signature)
(Mr. Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

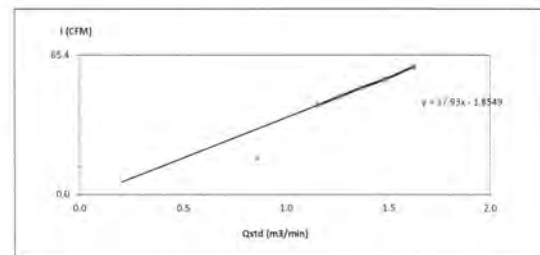
FORM NO.: E 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: GLOW ENERGY PUBLIC COMPANY LIMITED
Calibrate Location: โรงไฟฟ้าพลังงานแสงอาทิตย์ (A4)
Calibrate Date: 18-Apr-23
Calibration Sheet No.: C-180423-RYG_FS0173
Calibrator ID: RYG_FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 32
High Volume ID: RYG_FS0173
High Volume Model: TE-5170D
High Volume S/N: 4799
Calibrator Slope: 1.50765
Calibrator Intercept: -0.02043

| Test No. | Delta H ₂ O (inch) | Q _{std} (m ³ /min) | I: Chart (CFM) | Linear Regression |
|----------|-------------------------------|--|----------------|---|
| 1 | 3.0 | 1.1545 | 42 | Slope: 37.9300 Intercept: -1.8549 Correlation Coefficient: 0.9992 |
| 2 | 3.6 | 1.2628 | 46 | |
| 3 | 4.2 | 1.3623 | 50 | |
| 4 | 5.0 | 1.4945 | 54 | |
| 5 | 6.0 | 1.6243 | 60 | |



Calibrated by: Kantaphon M.
(Mr. Kantaphon Maneeesampan)
Field Scientist(2)

Approved by: (Signature)
(Mr. Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

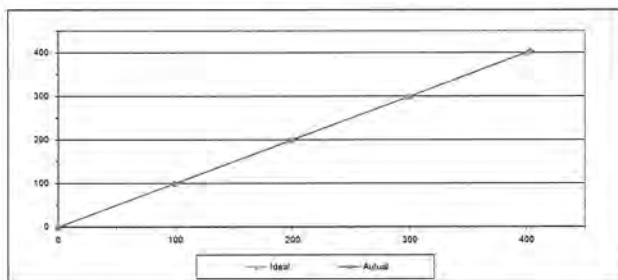
FORM NO.: E 06-073 REVISION NO.: ISSUE DATE: 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-23 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. XL29V85B Equipment ID RYG_FS0462
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | |
|-------------|---------------------|--------|-------|--------|
| | Ideal | Actual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.10 | -0.90 | -0.90 |
| 2 | 200.00 | 198.10 | -1.90 | -0.95 |
| 3 | 300.00 | 297.90 | -2.10 | -0.70 |
| 4 | 400.00 | 403.20 | 3.20 | 0.80 |
| AVERAGE (%) | | | | -0.33 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuht Jitranont)
Assistant General Manager

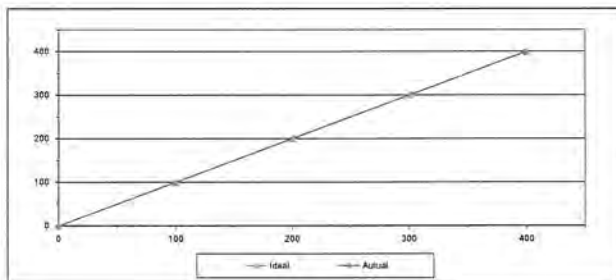
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-23 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. PAUVD77A Equipment ID RYG_FS0458
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | |
|-------------|---------------------|--------|-------|--------|
| | Ideal | Actual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 98.90 | -1.10 | -1.10 |
| 2 | 200.00 | 201.10 | 1.10 | 0.55 |
| 3 | 300.00 | 302.30 | 2.30 | 0.77 |
| 4 | 400.00 | 398.80 | -1.40 | -0.35 |
| AVERAGE (%) | | | | -0.01 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuht Jitranont)
Assistant General Manager

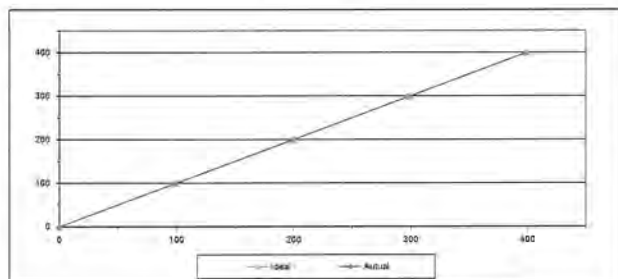
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-23 Equipment Name SO2 Analyzer
 Manufacturer Teledyne API Model T100
 Serial No. 1772 Equipment ID RYG_FS0254
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | |
|-------------|---------------------|--------|-------|--------|
| | Ideal | Actual | Error | %Error |
| ZERO | 0.00 | 0.05 | 0.05 | 0.05 |
| 1 | 100.00 | 99.10 | -0.90 | -0.90 |
| 2 | 200.00 | 199.50 | -0.50 | -0.25 |
| 3 | 300.00 | 297.50 | -2.50 | -0.83 |
| 4 | 400.00 | 398.80 | -1.20 | -0.30 |
| AVERAGE (%) | | | | -0.45 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuht Jitranont)
Assistant General Manager

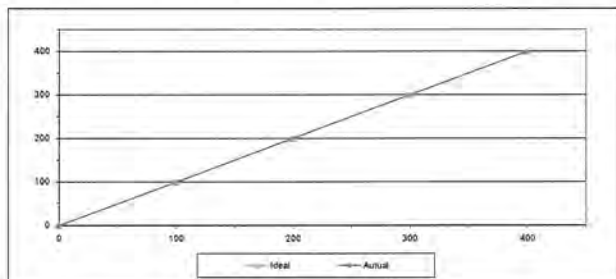
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jan-23 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. 90U0XJ31 Equipment ID RYG_FS0452
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | |
|-------------|---------------------|--------|-------|--------|
| | Ideal | Actual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 98.60 | -1.40 | -1.40 |
| 2 | 200.00 | 198.00 | -2.00 | -1.00 |
| 3 | 300.00 | 298.10 | -1.90 | -0.63 |
| 4 | 400.00 | 398.20 | -1.80 | -0.45 |
| AVERAGE (%) | | | | -0.68 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuht Jitranont)
Assistant General Manager

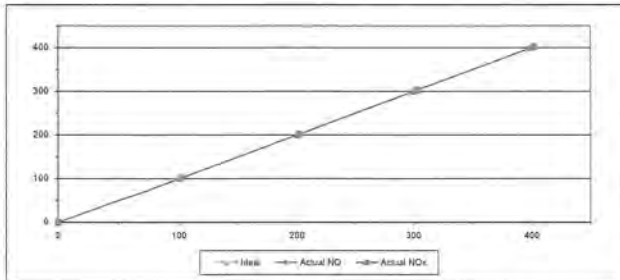
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. R06K0177 Equipment ID RYG_FS0463
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | | | | |
|-------------|---------------------|-----------|----------|-----------|------------|-----------|------------|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 98.60 | -1.20 | -1.20 | 101.10 | 1.10 | 1.10 |
| 2 | 200.00 | 201.80 | 1.80 | 0.90 | 201.50 | 1.50 | 0.75 |
| 3 | 300.00 | 299.40 | -0.60 | -0.20 | 302.60 | 2.60 | 0.87 |
| 4 | 400.00 | 398.10 | -1.90 | -0.47 | 401.90 | 1.90 | 0.47 |
| AVERAGE (%) | | | | -0.18 | | | 0.68 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

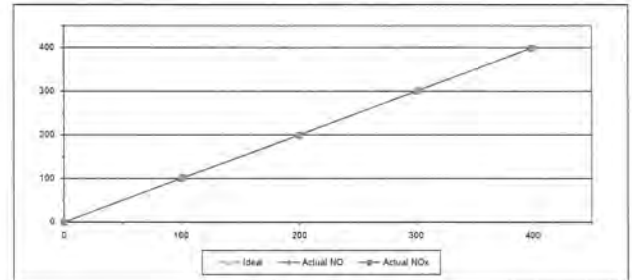
ALS Laboratory Group
FORM NO. 1-06-006 REVISION NO. 1 ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. NV0ER3YH Equipment ID RYG_FS0459
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | | | | |
|-------------|---------------------|-----------|----------|-----------|------------|-----------|------------|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.05 | 0.05 | 0.05 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.50 | -0.50 | -0.50 | 101.60 | 1.60 | 1.60 |
| 2 | 200.00 | 198.70 | -1.30 | -0.65 | 199.70 | -0.30 | -0.15 |
| 3 | 300.00 | 301.10 | 1.10 | 0.37 | 301.50 | 1.50 | 0.50 |
| 4 | 400.00 | 401.30 | 1.30 | 0.33 | 398.90 | -1.10 | -0.28 |
| AVERAGE (%) | | | | -0.08 | | | 0.39 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

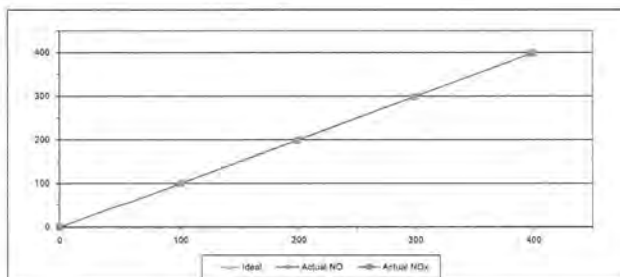
ALS Laboratory Group
FORM NO. 1-06-006 REVISION NO. 1 ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23 Equipment Name NOx Analyzer
 Manufacturer Teledyne API Model T200
 Serial No. 2197 Equipment ID RYG_FS0255
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | | | | |
|-------------|---------------------|-----------|----------|-----------|------------|-----------|------------|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.60 | -0.40 | -0.40 | 100.20 | 0.20 | 0.20 |
| 2 | 200.00 | 198.10 | -1.90 | -0.95 | 198.50 | -1.50 | -0.75 |
| 3 | 300.00 | 297.50 | -2.50 | -0.83 | 298.70 | -1.30 | -0.43 |
| 4 | 400.00 | 396.50 | -3.50 | -0.88 | 398.60 | -1.40 | -0.35 |
| AVERAGE (%) | | | | -0.59 | | | -0.25 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

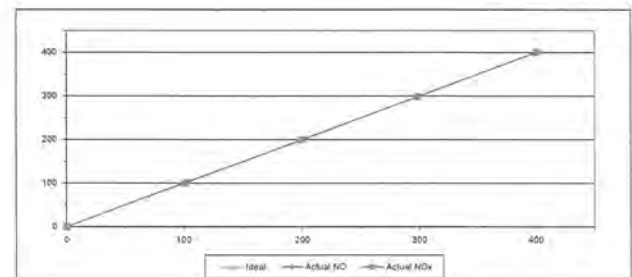
ALS Laboratory Group
FORM NO. 1-06-006 REVISION NO. 1 ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jan-23 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. AWXG87CR Equipment ID RYG_FS0453
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

| Point | CALIBRATION RESULTS | | | | | | |
|-------------|---------------------|-----------|----------|-----------|------------|-----------|------------|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.60 | -0.40 | -0.40 | 101.40 | 1.40 | 1.40 |
| 2 | 200.00 | 198.60 | -1.40 | -0.70 | 199.80 | -0.20 | -0.10 |
| 3 | 300.00 | 299.00 | -1.00 | -0.33 | 298.50 | -1.50 | -0.50 |
| 4 | 400.00 | 402.10 | 2.10 | 0.53 | 401.20 | 1.20 | 0.30 |
| AVERAGE (%) | | | | -0.18 | | | 0.24 |



Calibrated By

(Mr.Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group
FORM NO. 1-06-006 REVISION NO. 1 ISSUE DATE 02/04/12



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
63/24-25, 67/29-30
Pochrasaen 7, 7/1, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

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

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-010-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalyne
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-250L
SERIAL NUMBER : Sensor:
Data logger: A4986
ID NUMBER : RYG_F50087
CONDITION AS RECEIVED : Used item
CUSTOMER : AIS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10750 Thailand

RECEIVED DATE : 16 Jan 2023
MEASUREMENT DATE : 18 Jan 2023
ISSUE DATE : 20 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follows:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION : Effort type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION : Wind tunnel cross-section area¹ : 900 cm²
Wind direction frontal area² : 129 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.5)°C, (47.4) %RH and (1015.6) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
[X] Mr. Sarawit Thongkiet
[X] Miss Jitratana Jiratanateehol

Approved signature: Mr. Parinya Boonchatchan
Calibration Department Manager

Remarks:
¹ Hoely cross-section area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio $\frac{A_o}{A_t}$

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

Certificate Number

CL-010-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

| Air speed | D ₁ [m] | D ₂ [m] | Error | U (k=2) |
|-----------|--------------------|--------------------|------------|------------|
| m/s | Degree (°) | Degree (°) | Degree (°) | Degree (°) |
| 0.000 | 0 | 0 | 0 | 0.58 |
| 45.000 | 45 | 43 | -2 | 0.74 |
| 90.000 | 88 | 88 | -2 | 0.74 |
| 135.000 | 133 | 133 | -2 | 0.74 |
| 180.000 | 178 | 178 | -1 | 0.74 |
| 225.000 | 225 | 225 | 0 | 0.68 |
| 270.000 | 273 | 273 | 3 | 0.58 |
| 315.000 | 319 | 319 | 4 | 0.74 |

Remark:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
63/24-25, 67/29-30
Pochrasaen 7, 7/1, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 9



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
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E-mail: jirantee@jirantee.com
Website: www.jirantee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NAC-T07-T0 17025
CALIBRATION C067

Air speed measurement laboratory
Calibration services department



Certificate Number

CL-020-45

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS RECEIVED
CUSTOMER

Cup anemometer
Novatek
Sensor WS-02F
Data logger: 110-WS-2100-N
Sensor WS0-008
Data logger: AS400
NOH-F50055
Used item
ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanasak 40, Phatthanasak Rd, Phraeang, Sam Lung,
Khet Sam Lung, Bangkok 10250 Thailand

Calibration procedure:
The cup anemometer was calibrated against
Standard air velocity transducer against 0.455(92)
and 0.455(92) with precision differential pressure
meter model: DP42500 in ambient condition of
(0.01 bar wind tunnel with 3000 cm³ cross flow
section area. The WS-02F (0.01 bar) 0.455(92)
22.1 Wind energy generation system - Part 12
1. Power performance measurements of
electricity producing wind turbines, March 2017
and used as a reference standard.

Traceability:
This certificate provides a traceability of the
measurement to the realization of the international
system of units (SI) through the NIST (National
Bureau of Standards) of Thailand via Certificate
Number NIST-0052-21 and NIST-0066-22.

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

15 Dec 2022
20 Dec 2022
22 Dec 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 1.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area: 900 cm²
Wind direction: radial area: 100 cm²
Diameter of mounting pipe: 10 mm
Blockage ratio of test object: 0.111 (-)

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.9) °C, (44.2) %RH and (1014.2) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawee Thachakul
Mr. Kiatirattin Desarnaphol



Approved signature

Mr. Kiatirattin Desarnaphol
Calibration Department Manager

Remarks:

1. Validity cross-section area of the wind tunnel
2. Reported cross-section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Item: "a"

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

Certificate Number

CL-020-45

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exposed at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.3 m/s to 5 m/s was calibrated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was isolated 40 mm and 300 mm respectively away from wind tunnel intake. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in this range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainty are reported in the table below.

| UUC (m/s) | Temp. wind tunnel (°C) | Temp. room (°C) | U _{ref} (m/s) | Error (m/s) | U (k=2) (m/s) |
|--------------|---------------------------|--------------------|---------------------------|----------------|------------------|
| 0.993 | 23.90 | 23.90 | 0.8 | -0.2 | 0.15 |
| 2.041 | 23.96 | 23.90 | 1.8 | -0.2 | 0.16 |
| 3.090 | 23.76 | 23.90 | 2.8 | -0.1 | 0.17 |
| 4.146 | 23.90 | 23.90 | 3.8 | -0.2 | 0.20 |
| 5.02 | 23.70 | 23.90 | 4.8 | -0.2 | 0.17 |
| 6.01 | 24.00 | 23.90 | 5.8 | -0.2 | 0.18 |
| 7.05 | 23.54 | 23.90 | 6.8 | -0.1 | 0.18 |
| 8.16 | 23.90 | 23.90 | 7.8 | -0.2 | 0.19 |
| 9.11 | 23.50 | 23.86 | 8.8 | -0.1 | 0.19 |
| 10.01 | 24.00 | 23.90 | 9.8 | -0.1 | 0.21 |
| 11.17 | 23.56 | 23.90 | 10.8 | -0.1 | 0.20 |
| 12.15 | 23.94 | 23.90 | 11.8 | -0.1 | 0.21 |
| 13.20 | 23.70 | 23.90 | 12.8 | -0.1 | 0.25 |
| 14.27 | 23.82 | 23.90 | 13.8 | -0.2 | 0.23 |
| 15.26 | 23.70 | 23.90 | 14.8 | -0.2 | 0.21 |
| 16.30 | 23.76 | 23.90 | 15.8 | -0.2 | 0.23 |

Remark:

¹ Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place

² Velocity of standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jirantee Associates Co., Ltd. The cup anemometer (UUC) was exposed at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.3 m/s to 5 m/s was calibrated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was isolated 40 mm and 300 mm respectively away from wind tunnel intake. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in this range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainty are reported in the table below.

End of Certificate of Calibration
JIRANATEE ASSOCIATES CO., LTD.



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
40/4-15, RT.10, P.O. Box 10,
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Tel: +66(0)844211111
Fax: +66(0)844211111
E-mail: jirantee@jirantee.com
Website: www.jirantee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NAC-T07-T0 17025
CALIBRATION C067

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-020-45

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS RECEIVED
CUSTOMER

Wind direction sensor
Novatek
Sensor WS-02F
Data logger: 110-WS-2100-N
Sensor WS0-008
Data logger: AS400
NOH-F50055
Used item
ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanasak 40, Phatthanasak Rd, Phraeang, Sam Lung,
Khet Sam Lung, Bangkok 10250 Thailand

Calibration procedure:
The wind direction sensor was calibrated against
Standard air velocity transducer against 0.455(92)
and 0.455(92) with precision differential pressure
meter model: DP42500 in ambient condition of
(0.01 bar wind tunnel with 3000 cm³ cross flow
section area. The WS-02F (0.01 bar) 0.455(92)
22.1 Wind energy generation system - Part 12
1. Power performance measurements of
electricity producing wind turbines, March 2017 and used as a
reference standard.

Traceability:
This certificate provides a traceability of the
measurement to the realization of the international
system of units (SI) through the NIST (National
Bureau of Standards) of Thailand via Certificate
Number NIST-0052-21 and NIST-0066-22.

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

15 Dec 2022
20 Dec 2022
22 Dec 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature: 23.0 ± 1.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area: 900 cm²
Wind direction: radial area: 100 cm²
Diameter of mounting pipe: 10 mm
Blockage ratio of test object: 0.143 (-)

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.9) °C, (44.2) %RH and (1014.2) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawee Thachakul
Mr. Kiatirattin Desarnaphol



Approved signature

Mr. Kiatirattin Desarnaphol
Calibration Department Manager

Remarks:

1. Validity cross-section area of the wind tunnel
2. Reported cross-section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Item: "a"

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

Certificate Number

CL-020-45

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against Standard air velocity transducer by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (equally 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainty are reported in the table below.

| Air speed m/s | D _{ref} Degree (°) | D _{UUC} Degree (°) | Error Degree (°) | U (k=2) Degree (°) |
|------------------|--------------------------------|--------------------------------|---------------------|-----------------------|
| 5.01 | 0.000 | 0 | 0 | 0.18 |
| | 45.000 | 41 | -4 | 0.24 |
| | 90.000 | 47 | -3 | 0.28 |
| | 135.000 | 133 | -2 | 0.24 |
| | 180.000 | 180 | 0 | 0.24 |
| | 225.000 | 227 | -2 | 0.28 |
| | 270.000 | 274 | -4 | 0.24 |
| | 315.000 | 320 | -5 | 0.18 |

Remark:

¹ Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration
JIRANATEE ASSOCIATES CO., LTD.



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.
Wattana, Bangkok, Bangkok 10600 Thailand.
Tel: (66) 02-860812#13 Fax: (66) 02-8608060 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No.: RH2112022
Page 1 of 1 Page

Measurement Item: Relative humidity with data logger
Manufacturer: Novalyne
Model/Type: 110-WS-25DL-N
Serial Number: A5490
ID No.: NHH_F50055
Customer: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

Environmental Condition:

The measurement was carried out in an ambient temperature of 25.5(±0.5) and relative humidity of 55(±15)%

Measurement Method:

UUT Under Calibration (UUC) was calibrated by comparison against well calibrated thermal hygrometer in the humidity generator chamber to determine the error.

Traceability:

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the International System of Units (SI) via MCG Calibration, Inc. Certificate number: 20214-101 Due date: Mar. 14/2023

Measurement Date: Dec 21, 2022
Issue Date: Dec 22, 2022

Measurement Results:

The equipment was provided with indoor air quality probe and displayed 6.9% on display Model: HMP60, Serial number: R3440767.

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are recorded in table below.

| Determined (RH%) | Standard (RH%) | UUC Reading (RH%) | Error (RH%) | Uncertainty (RH%) |
|------------------|----------------|-------------------|-------------|-------------------|
| 20 | 20.04 | 18.8 | -1.2 | 0.02 |
| 50 | 50.31 | 48.0 | -2.3 | 0.02 |
| 80 | 80.24 | 78.4 | -1.8 | 0.02 |

Performed by:

☒ Mr. Sorwut Thachulad
☐ Miss Jiraporn Lertsomphol



Approved Signatory:

[Signature]
Mr. Pannya Booncharoen
Calibration Department Manager

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



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.
Wattana, Bangkok, Bangkok 10600 Thailand.
Tel: (66) 02-860812#13 Fax: (66) 02-8608060 www.jiranatee.com



CERTIFICATE OF CALIBRATION

Certificate No.: CL-205-65
Page 1 of 2

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novalyne
Model: 110-WS-25DL-N
Serial No.: A5490
ID No.: NHH_F50055

Customer: ALS laboratory group (Thailand) Co., Ltd.
Address: 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

Received date: 15 Dec 2022
Calibration date: 20 Dec 2022
Issue date: 22 Dec 2022

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 657082-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A Mk II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition:
Temperature: 23(±3) °C
Relative Humidity: 55(±15)%

Calibration Procedure

The temperature calibration was done by in-house calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS 90.

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0034-22, Certificate number: ER-0089-22

Calibrated by:

☒ Mr. Sorwut Thachulad
☐ Miss Jiraporn Lertsomphol



Approved Signatory:

[Signature]
Mr. Pannya Booncharoen
Calibration Department Manager

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



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd.
Wattana, Bangkok, Bangkok 10600 Thailand.
Tel: (66) 02-860812#13 Fax: (66) 02-8608060 www.jiranatee.com



Certificate No.: CL-205-65
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-80 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: R3440767.

Dimension: Diameter 12 mm, Length 80 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 80 | 20.064 | 19.8 | -0.2 | 0.16 |
| 80 | 25.061 | 24.6 | -0.3 | 0.099 |
| 80 | 30.048 | 29.7 | -0.3 | 0.16 |
| 80 | 35.045 | 34.7 | -0.3 | 0.099 |
| 80 | 40.038 | 39.7 | -0.3 | 0.099 |

UUC Under Calibration:

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



Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TD-TS 17025
CALIBRATION C867
Air speed measurement laboratory
Calibration services department

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TD-TS 17025
CALIBRATION C867

Air speed measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER: Novalyne

MODEL/TYPE: Sensor WS-021

DATA LOGGER: WS-25DL

SERIAL NUMBER: Sensor

ID NUMBER: Data logger: A5490

CONDITION AS RECEIVED: BAC: F50143

CUSTOMER: UUT item

Calibration procedure:

The cup anemometer was calibrated against standard air velocity transducer against 845-022 and air flow tube with orifice differential pressure meter model: DP42502 in an air flow section of 1500 mm³/s and 1500 mm³/s, wind test section area. The WS-021 used in EC 81400-12.1. Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines. Annex 2317 was used as a laboratory guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to verification of the international system of units (SI) through the NIMT (National Institute of Metrology of Thailand) via Certificate number: NIMT-0252-21 and NIMT-0086-22

Uncertainty of Measurement:

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

PLACE OF CALIBRATION

Effect type wind tunnel of Jiranatee Associates Co., Ltd

CALIBRATION CONDITIONS

Wind tunnel cross section area¹: 800 m²
Wind direction frontal area²: 100 m²
Diameter of mounting pipe³: 100 mm
Backsight ratio of test object⁴: 0.111

Preconditioning

Measurement Condition: 24 hours at ambient conditions

The storage values during measurement are 24 (°C), 50 (°C), 50 (°C) and 1014 (°C) RH

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

☒ Mr. Sorwut Thachulad
☐ Miss Jiraporn Lertsomphol



Approved signatory:

[Signature]
Mr. Pannya Booncharoen
Calibration Department Manager

Remarks:

¹ Hoody, small portion area of the wind tunnel
² Projected cross-section area of the test object includes mounting pipe
³ Diameter of mounting pipe
⁴ Ratio: $\frac{A}{B}$

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

Certificate Number

CL-002-ME

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, wind tunnel calibration (UUC) was carried out at 30 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and at 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 330 mm respectively away from wind tunnel nozzle; UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

| V_{ref} (m/s) | Temp. wind tunnel (°C) | Temp. room (°C) | V_{meas} (m/s) | Error (m/s) | U (k=2) (m/s) |
|--------------------|---------------------------|--------------------|---------------------|----------------|--------------------|
| 0.988 | 24.10 | 24.00 | 0.7 | -0.3 | 0.18 |
| 2.034 | 23.96 | 24.00 | 1.7 | -0.3 | 0.16 |
| 3.051 | 24.05 | 24.00 | 2.8 | -0.2 | 0.20 |
| 4.138 | 24.00 | 24.00 | 3.9 | -0.2 | 0.18 |
| 4.98 | 24.00 | 24.00 | 4.8 | -0.1 | 0.16 |
| 5.96 | 24.00 | 24.00 | 5.8 | -0.1 | 0.18 |
| 7.05 | 23.80 | 24.00 | 6.9 | -0.1 | 0.21 |
| 8.18 | 23.50 | 24.00 | 8.0 | -0.2 | 0.21 |
| 9.09 | 23.72 | 24.00 | 9.1 | 0.0 | 0.20 |
| 10.09 | 23.80 | 24.00 | 9.8 | -0.3 | 0.24 |
| 11.16 | 23.80 | 24.00 | 11.1 | 0.1 | 0.28 |
| 12.13 | 23.50 | 24.00 | 12.1 | 0.0 | 0.28 |
| 13.21 | 23.90 | 24.00 | 13.2 | 0.0 | 0.34 |
| 14.27 | 23.96 | 24.00 | 14.4 | 0.3 | 0.22 |
| 15.26 | 23.88 | 24.00 | 15.1 | -0.1 | 0.27 |
| 16.32 | 24.00 | 24.00 | 16.4 | 0.1 | 0.28 |

Remark:
¹ Calibration results only valid for the test section conditions and measurement conditions during which calibration took place.
² Velocity of standard.
³ Values of Wind Tunnel Calibration.

PHOTO OF CALIBRATION SET UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown and after being the calibration set-up shown. The proportion of the set-up is not to scale.



J NAC
 JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.
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 Tel: +662-0581812
 Mobile: +662-0581812
 E-mail: jiranatee@jiranatee.com
 Web site: www.jiranatee.com

Accredited calibration laboratory
 ISO/IEC 17025:2017
 JSC-TIS-TIS 17025
 CALIBRATION 0387

Air speed measurement laboratory
 Calibration services department

Certificate Number

CL-002-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITION

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

E. M. Sornsil Thaisong

J. M. Sornsil Thaisong

J. M. Sornsil Thaisong

J. M. Sornsil Thaisong

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J. M. Sornsil Thaisong

Wind Direction Sensor

Manufacturer

Model/Type

Serial Number

ID Number

Condition as received

Customer

Received Date

Measurement Date

Issue Date

Environmental Conditions:

Ambient condition in the laboratory are as follows:

Temperature

Relative Humidity

Atmospheric Pressure

Place of Calibration

Calibration Condition

Preconditioning

Measurement Condition

Tabulation of Results:

The table on next page give the measured values

Calibrated by:

E. M. Sornsil Thaisong

J. M. Sornsil Thaisong

J. M. Sornsil Thaisong

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J. M. Sornsil Thaisong

Calibration procedure:

The wind direction sensor was calibrated against

Standard Rotary Encoder, model: AK40015

DMS4 P1 5-10 in an open test facility of 2 ft

type wind tunnel with 900 cm² open test facility

area. The VTCI 008 Encoder - IFC 81400 12-1

Wind energy generation system - Part 12-1

Power performance measurement of electricity

producing wind turbine, March 2017 was used as

a calibration guideline.

Traceability:

This certificate provides a traceability of the

measurement to recognized the national

standards, and to realization of the international

system of units (SI) through the NMAT (National

Metrology Institute of Thailand) via Certificate

Number: DA-554-22

Uncertainty of Measurement:

The reported uncertainty of measurement is

based on the standard uncertainty multiplied by a

coverage factor k=2, which for a normal

distribution corresponds to a coverage probability

of approximately 95%. The standard uncertainty

has been determined in accordance with the GUM

Evaluation of measurement

data - Guide to the expression of uncertainty in

measurement.

Date: Guide to the expression of uncertainty in

measurement.

Date: Guide to the expression of uncertainty in

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DIGITAL TEMPERATURE CALIBRATION DATA SHEET

| | | | |
|--------------------------|---------------------|--------------------------|------------------|
| Calibration Date : | 3 Jan 23 | Ambient Temperature (°C) | 30 |
| Calibration sheet No. : | C-030123-BKK_FS0537 | Relative Humidity (%) | 62 |
| Digital Temperature ID : | BKK_FS0537 | Reference Temperature ID | BKK_FS1144 |
| Serial No. : | 1508054 | Serial No. : | 201090006013 |
| Model : | XC-572-V | Model : | Digison-CC-VT-MS |
| | | Next Calibrate : | 31 Jan 23 |

| Location | Reference Temperature °C | Digital Temperature °C | Error °C | MPE | Pass / Fail |
|----------|-----------------------------|---------------------------|-------------|-----|-------------|
| Stack | 0 | 0 | 0 | ±3 | Pass |
| | 25 | 25 | 0 | ±3 | Pass |
| | 50 | 50 | 0 | ±3 | Pass |
| | 100 | 100 | 0 | ±3 | Pass |
| | 150 | 150 | 0 | ±3 | Pass |
| | 200 | 199 | -1 | ±3 | Pass |
| | 250 | 249 | -1 | ±3 | Pass |
| | 300 | 299 | -1 | ±3 | Pass |
| | 500 | 498 | -2 | ±3 | Pass |
| Probe | 100 | 101 | 1 | ±3 | Pass |
| | 120 | 121 | 1 | ±3 | Pass |
| | 140 | 141 | 1 | ±3 | Pass |
| Oven | 100 | 101 | 1 | ±3 | Pass |
| | 120 | 121 | 1 | ±3 | Pass |
| | 140 | 141 | 1 | ±3 | Pass |
| Filter | 100 | 101 | 1 | ±3 | Pass |
| | 120 | 121 | 1 | ±3 | Pass |
| | 140 | 141 | 1 | ±3 | Pass |
| Exit | 0 | 0 | 0 | ±3 | Pass |
| | 10 | 10 | 0 | ±3 | Pass |
| | 20 | 21 | 1 | ±3 | Pass |
| Meter | 0 | 0 | 0 | ±3 | Pass |
| | 25 | 25 | 0 | ±3 | Pass |
| | 50 | 50 | 0 | ±3 | Pass |
| AUX | 0 | 0 | 0 | ±3 | Pass |
| | 25 | 25 | 0 | ±3 | Pass |
| | 50 | 50 | 0 | ±3 | Pass |

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนที่อนุญาต

Calibrated by : Prasert S. Approved by : S.P.
 (Mr. Prasert Surakhan) (Mr. Samart Roon-ngan)
 Field Scientist (2) Specialist (1)

FORM NO. F-06-037 REVISION NO. 2 ISSUE DATE 8 Feb 23



Stopwatch Calibration Test Report

| | | | |
|------------------------------|----------|--------------------|----------|
| Calibration Date : | 3 Jan 23 | Next Cal. Date : | 3 Jul 23 |
| Barometric Pressure (mmHg) : | 759 | Temperature (°C) : | 27.0 |
| Relative Humidity (%) : | 55.0 | | |

| | | | |
|--------------------------|----------------------------|---------------------|------------|
| Reference Stopwatch Data | Console Control Meter Data | | |
| Stopwatch ID No. : | E18061 | Dry Gas Meter No. : | BKK_FS0536 |
| Model : | F808 | Model : | XC-572-V |
| Serial No. : | - | Serial No. : | 1924 |
| Calibration Date : | 8 Sep 20 | | |
| Certificate No. : | E-2009018 | | |

| Run No. | Time Actual (m:ss.ms) | Time Reading (m:ss) | Diff. (ms) | Diff. (min) |
|---------|-----------------------|---------------------|------------|-------------|
| 1 | 5:00:10 | 5:00 | 10 | 0.00017 |
| 2 | 5:00:11 | 5:00 | 11 | 0.00018 |
| 3 | 5:00:09 | 5:00 | 9 | 0.00015 |
| 4 | 5:00:08 | 5:00 | 8 | 0.00013 |
| 5 | 5:00:11 | 5:00 | 11 | 0.00016 |
| 6 | 5:00:10 | 5:00 | 10 | 0.00017 |
| 7 | 5:00:11 | 5:00 | 11 | 0.00016 |
| 8 | 5:00:12 | 5:00 | 12 | 0.00020 |
| 9 | 5:00:12 | 5:00 | 12 | 0.00020 |
| 10 | 5:00:12 | 5:00 | 12 | 0.00020 |
| Average | | | | 0.00018 |
| SD | | | | 0.00002 |

Calibrate by : Prasert S. Approved by : S.P.
 Mr. Prasert Surakhan Mr. Samart Roon-ngan
 Field Scientist (3) Specialist (1)



Pitot Tube Calibration Data

| | | | |
|------------------------------------|---------------------|---------------------|------------|
| Pitot Tube Identification Number : | BKK_FS0540 | Calibration Date : | 3 Jan 23 |
| Lab test duct Number : | 258-1-13-01 | Standard Pitot ID : | BKK_FS0441 |
| Calibration Sheet No. : | C-030123-BKK_FS0540 | Cp Standard : | 0.99 |

| Type S Pitot Tube Coefficient Data | | | | | |
|------------------------------------|------------------------------|--|--|-----------------|-----------------|
| | Type s pitot tube Leg A/B | Standard pitot tube (ΔP, mm H ₂ O) | Type s pitot tube (ΔP, mm H ₂ O) | Cp (s) Leg A | Cp (s) Leg B |
| Test 1 | A | 12.00 | 17.00 | 0.840 | - |
| | B | 12.00 | 17.00 | - | 0.840 |
| Test 2 | A | 12.00 | 17.00 | 0.840 | - |
| | B | 12.00 | 17.00 | - | 0.840 |
| Test 3 | A | 12.00 | 16.80 | 0.845 | - |
| | B | 12.00 | 16.80 | - | 0.845 |
| Cp | | | | 0.842 | 0.842 |

$$Cp(s) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P(t)}}$$

$$|Cp(t) - Cp(s)|_{max RE} \leq 0.01$$

$$Average deviation(A or B) = \frac{\sum [Cp(t) - Cp(A or B)]}{3} \text{ must } RE \leq 0.01$$

Calibrated by : Worachit Approved by : S.P.
 (Mr. Worachit Tongsom) (Mr. Samart Roon-ngan)
 Field Scientist (2) Specialist (1)

FORM NO. F-06-029 REVISION NO. 1 ISSUE DATE 11 Jul 22



Pitot Tube Calibration Data

| | | | |
|------------------------------------|---------------------|---------------------|------------|
| Pitot Tube Identification Number : | BKK_FS0541 | Calibration Date : | 3 Jan 23 |
| Lab test duct Number : | 258-1-13-01 | Standard Pitot ID : | BKK_FS0441 |
| Calibration Sheet No. : | C-030123-BKK_FS0541 | Cp Standard : | 0.99 |

| Type S Pitot Tube Coefficient Data | | | | | |
|------------------------------------|------------------------------|--|--|-----------------|-----------------|
| | Type s pitot tube Leg A/B | Standard pitot tube (ΔP, mm H ₂ O) | Type s pitot tube (ΔP, mm H ₂ O) | Cp (s) Leg A | Cp (s) Leg B |
| Test 1 | A | 12.00 | 17.00 | 0.840 | - |
| | B | 12.00 | 17.00 | - | 0.840 |
| Test 2 | A | 12.00 | 17.00 | 0.840 | - |
| | B | 12.00 | 17.00 | - | 0.840 |
| Test 3 | A | 12.00 | 16.80 | 0.845 | - |
| | B | 12.00 | 16.80 | - | 0.845 |
| Cp | | | | 0.842 | 0.842 |

$$Cp(s) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P(t)}}$$

$$|Cp(t) - Cp(s)|_{max RE} \leq 0.01$$

$$Average deviation(A or B) = \frac{\sum [Cp(t) - Cp(A or B)]}{3} \text{ must } RE \leq 0.01$$

Calibrated by : Worachit Approved by : S.P.
 (Mr. Worachit Tongsom) (Mr. Samart Roon-ngan)
 Field Scientist (2) Specialist (1)

FORM NO. F-06-029 REVISION NO. 1 ISSUE DATE 11 Jul 22



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

| | |
|---|---------------------------------|
| Calibration Date : 3 Jan 23 | Nozzle Set ID : BKH_F50542 |
| Calibration Sheet No. : C-030123-BKH_F50542 | Vernier Caliper ID : RYG_F50539 |

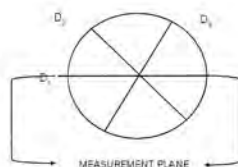
| Nozzle ID # | Nozzle Diameter (cm) | | | Hi - Lo | (D ₁ + D ₂ + D ₃) / 3 |
|-------------|----------------------|----------------|----------------|---------|---|
| | D ₁ | D ₂ | D ₃ | ΔD | D _{avg} |
| 1 | 0.315 | 0.315 | 0.315 | 0.000 | 0.315 |
| 2 | 0.475 | 0.475 | 0.475 | 0.000 | 0.475 |
| 3 | 0.635 | 0.635 | 0.635 | 0.000 | 0.635 |
| 4 | 0.790 | 0.790 | 0.790 | 0.000 | 0.790 |
| 5 | 0.950 | 0.950 | 0.950 | 0.000 | 0.950 |
| 6 | 1.110 | 1.110 | 1.110 | 0.000 | 1.110 |
| 7 | 1.270 | 1.270 | 1.270 | 0.000 | 1.270 |
| 8 | 1.600 | 1.600 | 1.600 | 0.000 | 1.600 |

Where:

D₁, D₂, D₃ = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm

ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm

D_{avg} = (D₁ + D₂ + D₃) / 3



Calibrated by

Worachit

() Mr. Worachit Tongpoom
Field Scientist (2)

Approved by

S.P.

() Mr. Saman Pongpan
Field Specialist (1)

Revision: 01-01-2023 (01-01-2023) 01-01-2023

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykong, Huaykong, Bangkok 10210
Tel: +66 2643 6361-6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

REVIEW BY: *Thailand*
APPROVED BY: *Thailand*
NEXT CAL DATE: 01/05/24

Model Number : MSE224S-100-DU Certificate No. : 23BCI0115
Description : Analytical Balance Issued Date : Friday, March 03, 2023
Serial Number : 0031709552 Reference No. : 204833
ID No : RYG_EN0003
Manufacturer : Sartorius Page No. : 1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Puak Daeng, Rayong 21140, Thailand

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
616/10 Moo 5 T. Maenam Khu, A. Puak Daeng, Rayong 21140, Thailand

Calibrated By : Mr. Chonchai Inthana Calibration Procedure No. : This calibration was conducted by
Calibration Date : Wednesday, March 01, 2023 Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data : Ambients Conditions :
Capacity : 220 g Readability : 0.0001 g Temperature : 23.0 °C ± 5.0 °C
Humidity : 56.0 % RH ± 10.0 % RH
Pressure : ±
Reasons for calibration : ☐ New Installation ☐ Service / Repair ☐ Re-saturation / Handover Equipment Condition : ☒ Good ☐ Poor

Measurement Method : UKAS Publication Ref : Lab 14
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realize the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

| Model Number | Description | Traceability | Certificate No. | Due Date |
|---------------|---|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2 YCS011-522-00 | SPC-RT | C02212585 | 14-Sep-2023 |
| MHB-382SD | Humidity/Balometer/Temp. Lutron MHB-382SD | DKSH | C19220444 | 5-Sep-2023 |

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division
Sartorius (Thailand) Co., Ltd.

Chonchai

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykong, Huaykong, Bangkok 10210
Tel: +66 2643 6361-6 Fax: +66 2643 6367 e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCI0115
Description : Analytical Balance Issued Date : Friday, March 03, 2023
Serial Number : 0031709552 Reference No. : 204833
ID No : RYG_EN0003
Manufacturer : Sartorius Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability

The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

| Nominal Value (Low Load) | 20 g | 200 g |
|--------------------------|-----------|-----------|
| Tolerance | ±0.0001 g | ±0.0005 g |
| Standard Deviation | 0.00004 | 0.00005 |

Eccentricity (Off-center loading error)

The off-center loading error is defined by the difference in the reading of the load, i.e. 1/2 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).

| Nominal value | 100 g | 1000 g |
|---------------|-----------|----------|
| Tolerance | ±0.0004 g | ±0.002 g |
| Difference | 0.0001 | 0.0005 |



Linearity

The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

| Tolerance | 0.0002 | g | | |
|---------------|-------------------------|-----------------|-----------|-------------|
| Nominal Value | Conventional Mass Value | Displayed Value | Deviation | Uncertainty |
| (g) | (g) | (g) | (g) | (g) |
| 0.01 | 0.0100 | 0.0100 | 0.0000 | 0.00013 |
| 0.05 | 0.0500 | 0.0500 | 0.0000 | 0.00013 |
| 0.1 | 0.1000 | 0.1000 | 0.0000 | 0.00013 |
| 0.5 | 0.5000 | 0.5000 | 0.0000 | 0.00014 |
| 1 | 1.0000 | 1.0000 | 0.0000 | 0.00012 |
| 5 | 5.0000 | 5.0000 | 0.0000 | 0.00014 |
| 10 | 10.0000 | 10.0000 | 0.0000 | 0.00014 |
| 20 | 20.0000 | 20.0000 | 0.0000 | 0.00024 |
| 50 | 50.0000 | 50.0000 | 0.0000 | 0.00015 |
| 100 | 100.0000 | 100.0000 | 0.0000 | 0.00019 |
| 200 | 200.0000 | 200.0001 | 0.0001 | 0.00032 |

End of Report

SOP FM 33 03 February 2022



Lot No. : 2321516-1

ANALYZER CALIBRATION DATA

Client : GLOW ENERGY PCL. Location : HRBG 41
Date : 20 Apr 23 Test Operator : Anurak M.

O₂ ANALYZER Model : TELEDYNE API T200H Serial No. : 822
Span (%) : 25

| | Cylinder Value (%) | Initial Analyzers Calibration Response (%) | Final Analyzers Calibration Response (%) | Difference (Percent of Span) |
|---------------|--------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.10 | 0.10 | 0.00 |
| Low-Level Gas | 8.00 | 8.11 | 8.00 | 0.44 |
| Span Gas | 16.17 | 15.88 | 16.00 | 0.48 |

NO₂ ANALYZER Model : TELEDYNE API T200H Serial No. : 822
Span (ppm) : 100

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.12 | 0.14 | 0.02 |
| Low-Level Gas | 50.41 | 49.88 | 50.48 | 0.60 |
| Span Gas | 80.43 | 79.79 | 79.23 | 0.56 |

SO₂ ANALYZER Model : TELEDYNE API T100H Serial No. : 834
Span (ppm) : 100

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.08 | 0.07 | 0.01 |
| Low-Level Gas | 51.61 | 51.23 | 51.00 | 0.23 |
| Span Gas | 80.56 | 79.85 | 80.01 | 0.16 |

CO ANALYZER Model : TELEDYNE API T300M Serial No. : 844
Span (ppm) : 100

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.07 | 0.15 | 0.08 |
| Low-Level Gas | 50.31 | 50.00 | 50.66 | 0.66 |
| Span Gas | 80.83 | 80.99 | 81.34 | 0.35 |

Calibrated by

Anurak

() Mr. Anurak Moungrai
Environmental Field Scientist (2)

FORM NO. 7 06-062 (REVISION NO. 2) ISSUE DATE: 30/01/19

ALS Laboratory Group



Lot No. 2321516-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : GLOW ENERGY PCL Location : HRSG 41
Date : 20 Apr 23 Test Operator : Anuvrat M.

O₂ ANALYZER : 18.17 Span (%) : 25
Cylinder Conc. (%)

| | O ₂ Analyzer Calibration Response | Initial Values | | Final Values | | Drift (% of Span) |
|--------------|--|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| | | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | |
| Zero Gas | 0.10 | 0.12 | 0.08 | 0.08 | 0.08 | 0.16 |
| Up-scale Gas | 15.88 | 16.00 | 0.48 | 16.13 | 1.50 | 0.52 |

NO_x ANALYZER : 80.43 Span (ppm) : 100
Cylinder Conc. (ppm)

| | NO _x Analyzer Calibration Response | Initial Values | | Final Values | | Drift (% of Span) |
|--------------|---|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| | | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | |
| Zero Gas | 0.12 | 0.11 | 0.01 | 0.13 | 0.01 | 0.02 |
| Up-scale Gas | 79.79 | 80.00 | 0.21 | 79.56 | 0.21 | 0.42 |

SO₂ ANALYZER : 80.58 Span (ppm) : 100
Cylinder Conc. (ppm)

| | SO ₂ Analyzer Calibration Response | Initial Values | | Final Values | | Drift (% of Span) |
|--------------|---|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| | | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | |
| Zero Gas | 0.08 | 0.08 | 0.00 | 0.08 | 0.03 | 0.03 |
| Up-scale Gas | 79.85 | 80.00 | 0.15 | 79.99 | 0.14 | 0.01 |

CO ANALYZER : 80.83 Span (ppm) : 100
Cylinder Conc. (ppm)

| | CO Analyzer Calibration Response | Initial Values | | Final Values | | Drift (% of Span) |
|--------------|----------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| | | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | |
| Zero Gas | 0.07 | 0.05 | 0.02 | 0.05 | 0.02 | 0.00 |
| Up-scale Gas | 80.99 | 80.66 | 0.33 | 80.88 | 0.11 | 0.22 |

Calibrated by

(Mr. Anuvrat Mungpali)

Environmental Field Scientist (2)

FORM NO. F-06-02 / REVISION NO. 2 / ISSUE DATE: 2006/19
ALS Laboratory Group

EMISSION TEST RESULT

Client : GLOW ENERGY PCL Run # : 1
Date : 20 Apr 23 Location : HRSG 41
Start Time : 10:30 Test Operator : Anuvrat M.
Finish Time : 12:00
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 534
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 922
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 10:30 | 12.56 | 4.87 | 20.71 | 0.23 | 0.64 | |
| 10:31 | 12.56 | 4.89 | 20.70 | 0.20 | 0.60 | |
| 10:32 | 12.55 | 4.87 | 20.63 | 0.23 | 0.62 | |
| 10:33 | 12.55 | 4.87 | 20.60 | 0.21 | 0.57 | |
| 10:34 | 12.55 | 4.87 | 20.55 | 0.19 | 0.56 | |
| 10:35 | 12.55 | 4.88 | 20.44 | 0.22 | 0.57 | |
| 10:36 | 12.56 | 4.88 | 20.22 | 0.23 | 0.58 | |
| 10:37 | 12.55 | 4.88 | 20.09 | 0.20 | 0.63 | |
| 10:38 | 12.58 | 4.87 | 19.87 | 0.21 | 0.63 | |
| 10:39 | 12.58 | 4.86 | 19.66 | 0.20 | 0.57 | |
| 10:40 | 12.57 | 4.86 | 20.02 | 0.18 | 0.62 | |
| 10:41 | 12.58 | 4.87 | 20.04 | 0.17 | 0.58 | |
| 10:42 | 12.58 | 4.86 | 20.01 | 0.20 | 0.57 | |
| 10:43 | 12.55 | 4.88 | 19.87 | 0.19 | 0.57 | |
| 10:44 | 12.52 | 4.88 | 19.62 | 0.19 | 0.56 | |
| 10:45 | 12.52 | 4.87 | 19.38 | 0.19 | 0.56 | |
| 10:46 | 12.51 | 4.89 | 19.45 | 0.18 | 0.60 | |
| 10:47 | 12.50 | 4.90 | 19.50 | 0.18 | 0.59 | |
| 10:48 | 12.54 | 4.89 | 19.54 | 0.18 | 0.58 | |
| 10:49 | 12.57 | 4.87 | 19.54 | 0.22 | 0.52 | |
| 10:50 | 12.58 | 4.88 | 19.56 | 0.20 | 0.58 | |
| Average | 12.58 | 4.87 | 20.02 | 0.20 | 0.60 | |

(Mr. Anuvrat Mungpali)

Environmental Field Scientist (2)

FORM NO. F-06-02 / REVISION NO. 2 / ISSUE DATE: 2006/19

ALS Laboratory Group



EMISSION TEST RESULT

Client : GLOW ENERGY PCL Run # : 2
Date : 20 Apr 23 Location : HRSG 41
Start Time : 10:51 Test Operator : Anuvrat M.
Finish Time : 11:11
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 534
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 922
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 10:51 | 12.59 | 4.85 | 19.56 | 0.16 | 0.72 | |
| 10:52 | 12.61 | 4.84 | 19.62 | 0.18 | 0.88 | |
| 10:53 | 12.68 | 4.83 | 19.76 | 0.19 | 0.89 | |
| 10:54 | 12.71 | 4.80 | 20.02 | 0.17 | 0.89 | |
| 10:55 | 12.70 | 4.77 | 20.16 | 0.16 | 0.69 | |
| 10:56 | 12.69 | 4.77 | 20.26 | 0.19 | 0.82 | |
| 10:57 | 12.67 | 4.80 | 20.33 | 0.17 | 0.64 | |
| 10:58 | 12.68 | 4.80 | 20.47 | 0.17 | 0.64 | |
| 10:59 | 12.66 | 4.81 | 20.33 | 0.16 | 0.68 | |
| 11:00 | 12.67 | 4.80 | 20.08 | 0.16 | 0.64 | |
| 11:01 | 12.70 | 4.79 | 19.71 | 0.16 | 0.58 | |
| 11:02 | 12.69 | 4.79 | 19.55 | 0.14 | 0.57 | |
| 11:03 | 12.67 | 4.80 | 19.52 | 0.14 | 0.60 | |
| 11:04 | 12.65 | 4.83 | 19.64 | 0.15 | 0.60 | |
| 11:05 | 12.64 | 4.85 | 19.86 | 0.15 | 0.61 | |
| 11:06 | 12.69 | 4.82 | 19.95 | 0.15 | 0.65 | |
| 11:07 | 12.74 | 4.77 | 19.97 | 0.12 | 0.66 | |
| 11:08 | 12.74 | 4.73 | 19.96 | 0.11 | 0.65 | |
| 11:09 | 12.70 | 4.74 | 19.96 | 0.11 | 0.67 | |
| 11:10 | 12.70 | 4.77 | 20.05 | 0.13 | 0.85 | |
| 11:11 | 12.65 | 4.81 | 20.23 | 0.12 | 0.94 | |
| Average | 12.67 | 4.80 | 19.95 | 0.15 | 0.69 | |

(Mr. Anuvrat Mungpali)

Environmental Field Scientist (2)

FORM NO. F-06-02 / REVISION NO. 2 / ISSUE DATE: 2006/19

ALS Laboratory Group



EMISSION TEST RESULT

Client : GLOW ENERGY PCL Run # : 3
Date : 20 Apr 23 Location : HRSG 41
Start Time : 11:12 Test Operator : Anuvrat M.
Finish Time : 11:32
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 534
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 922
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 11:12 | 12.58 | 4.82 | 20.47 | 0.13 | 0.61 | |
| 11:13 | 12.58 | 4.83 | 20.60 | 0.12 | 0.61 | |
| 11:14 | 12.72 | 4.81 | 20.57 | 0.21 | 0.61 | |
| 11:15 | 12.72 | 4.79 | 20.43 | 0.22 | 0.61 | |
| 11:16 | 12.63 | 4.78 | 20.40 | 0.23 | 0.64 | |
| 11:17 | 12.60 | 4.82 | 20.61 | 0.23 | 0.60 | |
| 11:18 | 12.57 | 4.83 | 20.83 | 0.22 | 0.56 | |
| 11:19 | 12.57 | 4.85 | 21.02 | 0.23 | 0.54 | |
| 11:20 | 12.58 | 4.87 | 21.08 | 0.25 | 0.59 | |
| 11:21 | 12.57 | 4.87 | 21.08 | 0.21 | 0.58 | |
| 11:22 | 12.59 | 4.87 | 21.19 | 0.22 | 0.55 | |
| 11:23 | 12.58 | 4.85 | 21.22 | 0.22 | 0.61 | |
| 11:24 | 12.57 | 4.85 | 21.54 | 0.22 | 0.67 | |
| 11:25 | 12.58 | 4.86 | 21.30 | 0.23 | 0.60 | |
| 11:26 | 12.56 | 4.85 | 21.42 | 0.24 | 0.59 | |
| 11:27 | 12.58 | 4.86 | 21.46 | 0.21 | 0.60 | |
| 11:28 | 12.57 | 4.87 | 21.63 | 0.23 | 0.59 | |
| 11:29 | 12.57 | 4.87 | 21.56 | 0.25 | 0.58 | |
| 11:30 | 12.64 | 4.86 | 21.63 | 0.22 | 0.61 | |
| 11:31 | 12.66 | 4.87 | 21.66 | 0.21 | 0.59 | |
| 11:32 | 12.60 | 4.81 | 21.61 | 0.22 | 0.64 | |
| Average | 12.61 | 4.84 | 21.10 | 0.21 | 0.59 | |

(Mr. Anuvrat Mungpali)

Environmental Field Scientist (2)

FORM NO. F-06-02 / REVISION NO. 2 / ISSUE DATE: 2006/19

ALS Laboratory Group



Lot No. 2321548-1

ANALYZER CALIBRATION DATA

Client : GLOW ENERGY PCL. Location : HRSG 42
Date : 20 Apr 23 Test Operator : Anuvul M.

O₂ ANALYZER
Model : TELEDYNE API T200H Serial No. : 822
Span (%) : 25

| | Cylinder Value (%) | Initial Analyzers Calibration Response (%) | Final Analyzers Calibration Response (%) | Difference (Percent of Span) |
|---------------|--------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.10 | 0.10 | 0.00 |
| Low-Level Gas | 8.00 | 8.11 | 8.00 | 0.44 |
| Span Gas | 16.17 | 15.88 | 16.00 | 0.48 |

NO_x ANALYZER
Model : TELEDYNE API T200H Serial No. : 822
Span (ppm) : 100

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.12 | 0.14 | 0.02 |
| Low-Level Gas | 50.41 | 48.88 | 50.48 | 0.60 |
| Span Gas | 80.43 | 79.79 | 79.23 | 0.56 |

SO₂ ANALYZER
Model : TELEDYNE API T100H Serial No. : 834
Span (ppm) : 100

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.08 | 0.07 | 0.01 |
| Low-Level Gas | 51.61 | 51.23 | 51.00 | 0.23 |
| Span Gas | 80.58 | 79.85 | 80.01 | 0.16 |

CO ANALYZER
Model : TELEDYNE API T300M Serial No. : 844
Span (ppm) : 100

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.07 | 0.15 | 0.08 |
| Low-Level Gas | 50.31 | 50.00 | 50.86 | 0.66 |
| Span Gas | 80.63 | 80.99 | 81.34 | 0.35 |

Calibrated by

(Mr. Anuvul Mungpair)
Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE 3/08/18
ALS Laboratory Group



Lot No. 2321548-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : GLOW ENERGY PCL. Location : HRSG 42
Date : 20 Apr 23 Test Operator : Anuvul M.

O₂ ANALYZER
Cylinder Conc. (%) : 16.17 Span (%) : 25

| | O ₂ Analyzer Calibration Response | Initial Values System Calibration Response System Cal Bias (% of Span) | Final Values System Calibration Response System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|--|--|--|-------------------|
| Zero Gas | 0.10 | 0.12 | 0.08 | 0.08 |
| Upscale Gas | 15.88 | 16.00 | 16.13 | 1.00 |

NO_x ANALYZER
Cylinder Conc. (ppm) : 80.43 Span (ppm) : 100

| | NO _x Analyzer Calibration Response | Initial Values System Calibration Response System Cal Bias (% of Span) | Final Values System Calibration Response System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|---|--|--|-------------------|
| Zero Gas | 0.12 | 0.11 | 0.13 | 0.01 |
| Upscale Gas | 79.79 | 80.00 | 79.58 | 0.21 |

SO₂ ANALYZER
Cylinder Conc. (ppm) : 80.58 Span (ppm) : 100

| | SO ₂ Analyzer Calibration Response | Initial Values System Calibration Response System Cal Bias (% of Span) | Final Values System Calibration Response System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|---|--|--|-------------------|
| Zero Gas | 0.08 | 0.08 | 0.05 | 0.03 |
| Upscale Gas | 79.85 | 80.00 | 79.99 | 0.14 |

CO ANALYZER
Cylinder Conc. (ppm) : 80.63 Span (ppm) : 100

| | CO Analyzer Calibration Response | Initial Values System Calibration Response System Cal Bias (% of Span) | Final Values System Calibration Response System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|----------------------------------|--|--|-------------------|
| Zero Gas | 0.07 | 0.05 | 0.05 | 0.00 |
| Upscale Gas | 80.99 | 80.65 | 80.86 | 0.11 |

Calibrated by

(Mr. Anuvul Mungpair)
Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE 3/08/18
ALS Laboratory Group



EMISSION TEST RESULT

Client : GLOW ENERGY PCL. Run # : 1
Date : 20 Apr 23 Location : HRSG 42
Start Time : 12:25 Test Operator : Anuvul M.
Finish Time : 12:45
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 834
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 822
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 12:25 | 12.99 | 4.59 | 19.62 | 0.25 | 0.49 | |
| 12:26 | 12.98 | 4.60 | 19.76 | 0.30 | 0.48 | |
| 12:27 | 12.99 | 4.61 | 19.85 | 0.29 | 0.44 | |
| 12:28 | 12.99 | 4.60 | 19.80 | 0.31 | 0.42 | |
| 12:29 | 13.00 | 4.60 | 19.80 | 0.28 | 0.43 | |
| 12:30 | 13.04 | 4.60 | 19.62 | 0.27 | 0.46 | |
| 12:31 | 13.06 | 4.57 | 19.76 | 0.31 | 0.51 | |
| 12:32 | 13.08 | 4.56 | 19.71 | 0.30 | 0.51 | |
| 12:33 | 13.10 | 4.56 | 19.68 | 0.32 | 0.50 | |
| 12:34 | 13.12 | 4.53 | 19.67 | 0.26 | 0.53 | |
| 12:35 | 13.16 | 4.62 | 19.62 | 0.26 | 0.58 | |
| 12:36 | 13.13 | 4.61 | 19.52 | 0.34 | 0.63 | |
| 12:37 | 13.07 | 4.52 | 19.50 | 0.34 | 0.58 | |
| 12:38 | 13.02 | 4.57 | 19.77 | 0.32 | 0.53 | |
| 12:39 | 12.99 | 4.60 | 20.00 | 0.27 | 0.47 | |
| 12:40 | 12.99 | 4.61 | 20.36 | 0.25 | 0.47 | |
| 12:41 | 12.96 | 4.60 | 20.36 | 0.31 | 0.40 | |
| 12:42 | 13.00 | 4.60 | 20.29 | 0.26 | 0.42 | |
| 12:43 | 12.98 | 4.60 | 20.27 | 0.56 | 0.46 | |
| 12:44 | 12.96 | 4.61 | 20.27 | 0.24 | 0.43 | |
| 12:45 | 12.91 | 4.64 | 20.37 | 0.15 | 0.43 | |
| Average | 13.03 | 4.68 | 19.90 | 0.29 | 0.48 | |

(Mr. Anuvul Mungpair)
Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE 3/08/18
ALS Laboratory Group



EMISSION TEST RESULT

Client : GLOW ENERGY PCL. Run # : 2
Date : 20 Apr 23 Location : HRSG 42
Start Time : 12:46 Test Operator : Anuvul M.
Finish Time : 13:06
SO₂ Analyzer Model : TELEDYNE API T100H Serial No. : 834
NO_x/O₂ Analyzer Model : TELEDYNE API T200H Serial No. : 822
CO/CO₂ Analyzer Model : TELEDYNE API T300M Serial No. : 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 12:46 | 12.87 | 4.66 | 20.66 | 0.16 | 0.52 | |
| 12:47 | 12.90 | 4.68 | 20.90 | 0.20 | 0.50 | |
| 12:48 | 12.97 | 4.66 | 20.96 | 0.26 | 0.56 | |
| 12:49 | 13.04 | 4.67 | 20.94 | 0.22 | 0.46 | |
| 12:50 | 13.08 | 4.67 | 20.62 | 0.21 | 0.48 | |
| 12:51 | 13.07 | 4.56 | 20.50 | 0.16 | 0.52 | |
| 12:52 | 13.04 | 4.59 | 20.66 | 0.21 | 0.51 | |
| 12:53 | 12.99 | 4.59 | 20.76 | 0.24 | 0.47 | |
| 12:54 | 12.86 | 4.61 | 21.02 | 0.22 | 0.52 | |
| 12:55 | 12.80 | 4.68 | 21.47 | 0.22 | 0.56 | |
| 12:56 | 12.75 | 4.73 | 21.68 | 0.24 | 0.53 | |
| 12:57 | 12.79 | 4.75 | 21.76 | 0.22 | 0.53 | |
| 12:58 | 12.75 | 4.75 | 21.86 | 0.23 | 0.59 | |
| 12:59 | 12.74 | 4.79 | 21.68 | 0.21 | 0.58 | |
| 13:00 | 12.77 | 4.75 | 21.96 | 0.24 | 0.56 | |
| 13:01 | 12.83 | 4.73 | 21.86 | 0.23 | 0.53 | |
| 13:02 | 12.97 | 4.75 | 21.80 | 0.23 | 0.59 | |
| 13:03 | 13.01 | 4.60 | 21.67 | 0.23 | 0.43 | |
| 13:04 | 13.11 | 4.59 | 21.34 | 0.21 | 0.48 | |
| 13:05 | 13.10 | 4.54 | 21.54 | 0.24 | 0.56 | |
| 13:06 | 13.08 | 4.54 | 21.09 | 0.24 | 0.54 | |
| Average | 12.93 | 4.64 | 21.29 | 0.23 | 0.58 | |

(Mr. Anuvul Mungpair)
Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE 3/08/18
ALS Laboratory Group



EMISSION TEST RESULT

| | | | |
|--|--------------------|---------------|------------|
| Client | GLOW ENERGY PCL | Run # | 3 |
| Date | 20 Apr 23 | Location | HRSG 42 |
| Start Time | 13:07 | Test Operator | Anuvrat M. |
| SO ₂ Analyzer Model | TELEDYNE API T100H | Finish Time | 13:27 |
| NO _x /O ₂ Analyzer Model | TELEDYNE API T200H | Serial No. | 534 |
| CO/CO ₂ Analyzer Model | TELEDYNE API T300H | Serial No. | 822 |
| | | Serial No. | 844 |

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 13:07 | 13.01 | 4.55 | 21.15 | 0.25 | 0.45 | |
| 13:08 | 13.06 | 4.62 | 21.34 | 0.25 | 0.45 | |
| 13:09 | 13.12 | 4.59 | 21.45 | 0.21 | 0.51 | |
| 13:10 | 13.15 | 4.53 | 21.55 | 0.23 | 0.65 | |
| 13:11 | 13.15 | 4.51 | 21.59 | 0.23 | 0.61 | |
| 13:12 | 13.16 | 4.52 | 21.70 | 0.26 | 0.60 | |
| 13:13 | 13.12 | 4.53 | 21.79 | 0.27 | 0.58 | |
| 13:14 | 13.04 | 4.54 | 21.89 | 0.17 | 0.53 | |
| 13:15 | 13.09 | 4.57 | 22.10 | 0.14 | 0.42 | |
| 13:16 | 13.00 | 4.61 | 22.47 | 0.17 | 0.37 | |
| 13:17 | 12.98 | 4.59 | 22.83 | 0.17 | 0.39 | |
| 13:18 | 12.99 | 4.61 | 22.28 | 0.22 | 0.38 | |
| 13:19 | 12.99 | 4.62 | 23.01 | 0.20 | 0.36 | |
| 13:20 | 13.02 | 4.61 | 22.95 | 0.17 | 0.37 | |
| 13:21 | 13.04 | 4.59 | 23.15 | 0.16 | 0.35 | |
| 13:22 | 13.08 | 4.56 | 23.24 | 0.21 | 0.41 | |
| 13:23 | 13.10 | 4.54 | 23.07 | 0.21 | 0.50 | |
| 13:24 | 13.08 | 4.54 | 22.77 | 0.21 | 0.45 | |
| 13:25 | 13.04 | 4.55 | 22.75 | 0.16 | 0.45 | |
| 13:26 | 13.03 | 4.55 | 22.96 | 0.21 | 0.45 | |
| 13:27 | 13.01 | 4.57 | 23.15 | 0.21 | 0.42 | |
| Average | 13.05 | 4.57 | 22.38 | 0.21 | 0.48 | |

(Mr. Anuvrat Mungpak)

Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



Lot No. 2344412-1

ANALYZER CALIBRATION DATA

| | | | |
|-------------------------|--------------------|---------------|------------|
| Client | GLOW ENERGY PCL | Location | HRSG 81 |
| Date | 18 Apr 23 | Test Operator | Anuvrat M. |
| O ₂ ANALYZER | | Serial No. | 822 |
| Model | TELEDYNE API T200H | | |
| Span (%) | 25 | | |

| | Cylinder Value (%) | Initial Analyzers Calibration Response (%) | Final Analyzers Calibration Response (%) | Difference (Percent of Span) |
|---------------|--------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.05 | 0.08 | 0.12 |
| Low-Level Gas | 8.00 | 8.11 | 8.13 | 0.08 |
| Span Gas | 16.17 | 15.88 | 15.98 | 0.40 |

| | | | |
|--------------------------|--------------------|------------|-----|
| NO _x ANALYZER | | Serial No. | 534 |
| Model | TELEDYNE API T200H | | |
| Span (ppm) | 100 | | |

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.12 | 0.14 | 0.02 |
| Low-Level Gas | 50.41 | 49.88 | 50.45 | 0.60 |
| Span Gas | 80.43 | 80.79 | 80.55 | 0.24 |

| | | | |
|--------------------------|--------------------|------------|-----|
| SO ₂ ANALYZER | | Serial No. | 844 |
| Model | TELEDYNE API T100H | | |
| Span (ppm) | 100 | | |

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.14 | 0.12 | 0.02 |
| Low-Level Gas | 51.61 | 51.23 | 51.00 | 0.23 |
| Span Gas | 80.58 | 79.85 | 80.01 | 0.16 |

| | | | |
|-------------|--------------------|------------|-----|
| CO ANALYZER | | Serial No. | 844 |
| Model | TELEDYNE API T300H | | |
| Span (ppm) | 100 | | |

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.07 | 0.15 | 0.08 |
| Low-Level Gas | 50.31 | 50.78 | 50.66 | 0.12 |
| Span Gas | 80.83 | 81.23 | 81.34 | 0.11 |

Calibrated by

(Mr. Anuvrat Mungpak)

Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



Lot No. 2344412-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

| | | | |
|--------|-----------------|---------------|------------|
| Client | GLOW ENERGY PCL | Location | HRSG 81 |
| Date | 18 Apr 23 | Test Operator | Anuvrat M. |

| | | | |
|-------------------------|-------|----------|----|
| O ₂ ANALYZER | | Span (%) | 25 |
| Cylinder Conc. (%) | 16.17 | | |

| | O ₂ Analyzer Calibration Response | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|--|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| Zero Gas | 0.05 | 0.12 | 0.28 | 0.08 | 0.12 | 0.16 |
| Upscale Gas | 15.88 | 16.00 | 0.48 | 16.13 | 1.00 | 0.52 |

| | | | |
|--------------------------|-------|------------|-----|
| NO _x ANALYZER | | Span (ppm) | 100 |
| Cylinder Conc. (ppm) | 80.43 | | |

| | NO _x Analyzer Calibration Response | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|---|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| Zero Gas | 0.12 | 0.11 | 0.01 | 0.13 | 0.01 | 0.02 |
| Upscale Gas | 80.79 | 80.00 | 0.79 | 79.58 | 1.21 | 0.42 |

| | | | |
|--------------------------|-------|------------|-----|
| SO ₂ ANALYZER | | Span (ppm) | 100 |
| Cylinder Conc. (ppm) | 80.58 | | |

| | SO ₂ Analyzer Calibration Response | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|---|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| Zero Gas | 0.14 | 0.08 | 0.06 | 0.05 | 0.09 | 0.03 |
| Upscale Gas | 79.85 | 79.55 | 0.30 | 79.99 | 0.14 | 0.44 |

| | | | |
|----------------------|-------|------------|-----|
| CO ANALYZER | | Span (ppm) | 100 |
| Cylinder Conc. (ppm) | 80.83 | | |

| | CO Analyzer Calibration Response | System Calibration Response | System Cal Bias (% of Span) | System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|----------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
| Zero Gas | 0.07 | 0.05 | 0.02 | 0.13 | 0.06 | 0.08 |
| Upscale Gas | 81.23 | 81.03 | 0.23 | 80.88 | 0.35 | 0.12 |

Calibrated by

(Mr. Anuvrat Mungpak)

Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



EMISSION TEST RESULT

| | | | |
|--|--------------------|---------------|------------|
| Client | GLOW ENERGY PCL | Run # | 1 |
| Date | 18 Apr 23 | Location | HRSG 81 |
| Start Time | 11:06 | Test Operator | Anuvrat M. |
| SO ₂ Analyzer Model | TELEDYNE API T100H | Finish Time | 11:25 |
| NO _x /O ₂ Analyzer Model | TELEDYNE API T200H | Serial No. | 534 |
| CO/CO ₂ Analyzer Model | TELEDYNE API T300H | Serial No. | 822 |
| | | Serial No. | 844 |

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 11:06 | 12.78 | 4.77 | 18.54 | 0.19 | 0.48 | |
| 11:07 | 12.82 | 4.76 | 18.30 | 0.19 | 0.43 | |
| 11:08 | 12.81 | 4.74 | 18.00 | 0.21 | 0.44 | |
| 11:09 | 12.81 | 4.75 | 18.18 | 0.21 | 0.46 | |
| 11:10 | 12.85 | 4.74 | 18.49 | 0.25 | 0.48 | |
| 11:11 | 12.81 | 4.73 | 18.69 | 0.26 | 0.49 | |
| 11:12 | 12.89 | 4.71 | 18.85 | 0.25 | 0.58 | |
| 11:13 | 12.92 | 4.71 | 18.99 | 0.26 | 0.62 | |
| 11:14 | 12.88 | 4.69 | 19.21 | 0.25 | 0.57 | |
| 11:15 | 12.88 | 4.69 | 19.61 | 0.26 | 0.63 | |
| 11:16 | 12.85 | 4.69 | 19.83 | 0.23 | 0.60 | |
| 11:17 | 12.84 | 4.72 | 19.95 | 0.25 | 0.49 | |
| 11:18 | 12.85 | 4.71 | 20.04 | 0.26 | 0.48 | |
| 11:19 | 12.83 | 4.74 | 20.14 | 0.22 | 0.42 | |
| 11:20 | 12.84 | 4.74 | 20.28 | 0.20 | 0.43 | |
| 11:21 | 12.82 | 4.74 | 20.38 | 0.21 | 0.42 | |
| 11:22 | 12.84 | 4.73 | 20.47 | 0.24 | 0.43 | |
| 11:23 | 12.84 | 4.74 | 20.45 | 0.20 | 0.43 | |
| 11:24 | 12.85 | 4.73 | 20.55 | 0.18 | 0.49 | |
| 11:25 | 12.90 | 4.73 | 20.62 | 0.20 | 0.53 | |
| 11:26 | 12.92 | 4.71 | 20.67 | 0.18 | 0.60 | |
| Average | 12.86 | 4.72 | 19.63 | 0.22 | 0.48 | |

(Mr. Anuvrat Mungpak)

Environmental Field Scientist (2)

FORM NO. F-08-002 REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



EMISSION TEST RESULT

Client: GLOW ENERGY PCL
Date: 19 Apr 23
Start Time: 11:28
SO₂ Analyzer Model: TELEDYNE API T100H
NO_x/CO Analyzer Model: TELEDYNE API T300H
CO/CO₂ Analyzer Model: TELEDYNE API T300M

Run # 2
Location: HRSG B1
Test Operator: Anusut M.
Finish Time: 11:48
Serial No: 534
Serial No: 922
Serial No: 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 11:29 | 12.69 | 4.89 | 20.44 | 0.20 | 0.56 | |
| 11:27 | 12.84 | 4.71 | 20.35 | 0.21 | 0.56 | |
| 11:28 | 12.82 | 4.72 | 20.45 | 0.23 | 0.48 | |
| 11:29 | 12.82 | 4.78 | 20.52 | 0.24 | 0.40 | |
| 11:30 | 12.81 | 4.78 | 20.50 | 0.23 | 0.51 | |
| 11:31 | 12.79 | 4.76 | 20.48 | 0.24 | 0.48 | |
| 11:32 | 12.78 | 4.76 | 20.43 | 0.25 | 0.43 | |
| 11:33 | 12.79 | 4.78 | 20.39 | 0.25 | 0.41 | |
| 11:34 | 12.80 | 4.77 | 20.27 | 0.25 | 0.45 | |
| 11:35 | 12.80 | 4.78 | 20.10 | 0.19 | 0.38 | |
| 11:36 | 12.84 | 4.78 | 20.04 | 0.21 | 0.38 | |
| 11:37 | 12.90 | 4.74 | 19.93 | 0.21 | 0.42 | |
| 11:38 | 12.94 | 4.68 | 19.72 | 0.25 | 0.49 | |
| 11:39 | 12.92 | 4.66 | 19.41 | 0.26 | 0.40 | |
| 11:40 | 12.91 | 4.68 | 19.26 | 0.25 | 0.42 | |
| 11:41 | 12.90 | 4.70 | 19.32 | 0.25 | 0.38 | |
| 11:42 | 12.87 | 4.70 | 19.37 | 0.25 | 0.38 | |
| 11:43 | 12.87 | 4.71 | 19.30 | 0.26 | 0.40 | |
| 11:44 | 12.84 | 4.69 | 19.34 | 0.23 | 0.39 | |
| 11:45 | 12.89 | 4.69 | 19.46 | 0.25 | 0.42 | |
| 11:46 | 12.93 | 4.69 | 19.54 | 0.24 | 0.45 | |
| Average | 12.88 | 4.72 | 19.93 | 0.24 | 0.43 | |

(Mr. Anusut Moungpak)

Environmental Field Scientist (2)

FORM NO. P 06-082 REVISION NO. 2 ISSUE DATE 3/8/19

ALS Laboratory Group



EMISSION TEST RESULT

Client: GLOW ENERGY PCL
Date: 19 Apr 23
Start Time: 11:47
SO₂ Analyzer Model: TELEDYNE API T100H
NO_x/CO Analyzer Model: TELEDYNE API T300H
CO/CO₂ Analyzer Model: TELEDYNE API T300M

Run # 3
Location: HRSG B1
Test Operator: Anusut M.
Finish Time: 12:07
Serial No: 834
Serial No: 922
Serial No: 844

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 11:47 | 12.56 | 4.99 | 19.37 | 0.22 | 0.39 | |
| 11:48 | 12.92 | 4.67 | 19.28 | 0.22 | 0.34 | |
| 11:49 | 12.93 | 4.67 | 19.40 | 0.21 | 0.51 | |
| 11:50 | 12.92 | 4.67 | 19.53 | 0.24 | 0.45 | |
| 11:51 | 12.90 | 4.67 | 19.67 | 0.20 | 0.43 | |
| 11:52 | 12.88 | 4.68 | 19.84 | 0.18 | 0.41 | |
| 11:53 | 12.85 | 4.71 | 19.93 | 0.20 | 0.40 | |
| 11:54 | 12.85 | 4.71 | 19.94 | 0.14 | 0.38 | |
| 11:55 | 12.90 | 4.70 | 20.12 | 0.20 | 0.38 | |
| 11:56 | 12.89 | 4.69 | 20.13 | 0.21 | 0.42 | |
| 11:57 | 12.82 | 4.70 | 20.06 | 0.23 | 0.49 | |
| 11:58 | 12.82 | 4.71 | 20.27 | 0.24 | 0.40 | |
| 11:59 | 12.84 | 4.75 | 20.52 | 0.23 | 0.42 | |
| 12:00 | 12.85 | 4.75 | 20.57 | 0.24 | 0.39 | |
| 12:01 | 12.87 | 4.75 | 20.51 | 0.25 | 0.38 | |
| 12:02 | 12.90 | 4.68 | 20.62 | 0.25 | 0.40 | |
| 12:03 | 12.90 | 4.68 | 20.74 | 0.25 | 0.39 | |
| 12:04 | 12.92 | 4.69 | 20.71 | 0.23 | 0.42 | |
| 12:05 | 12.87 | 4.68 | 20.66 | 0.24 | 0.38 | |
| 12:06 | 12.86 | 4.68 | 20.45 | 0.23 | 0.36 | |
| 12:07 | 12.84 | 4.70 | 20.57 | 0.24 | 0.34 | |
| Average | 12.88 | 4.69 | 20.14 | 0.22 | 0.40 | |

(Mr. Anusut Moungpak)

Environmental Field Scientist (2)

FORM NO. P 06-082 REVISION NO. 2 ISSUE DATE 3/8/19

ALS Laboratory Group



ANALYZER CALIBRATION DATA

Client: GLOW ENERGY PCL
Date: 19 Apr 23
O₂ ANALYZER Model: TELEDYNE API T200H
Span (%) : 25
Location: HRSG B2
Test Operator: Anusut M.
Serial No: 922

| | Cylinder Value (%) | Initial Analyzers Calibration Response (%) | Final Analyzers Calibration Response (%) | Difference (Percent of Span) |
|---------------|--------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.05 | 0.03 | 0.12 |
| Low-Level Gas | 8.00 | 8.11 | 8.13 | 0.06 |
| Span Gas | 16.17 | 15.88 | 15.98 | 0.40 |

NO_x ANALYZER Model: TELEDYNE API T200H
Span (ppm) : 100
Serial No: 922

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.12 | 0.14 | 0.02 |
| Low-Level Gas | 50.41 | 49.88 | 50.48 | 0.80 |
| Span Gas | 80.43 | 80.79 | 80.55 | 0.24 |

SO₂ ANALYZER Model: TELEDYNE API T100H
Span (ppm) : 100
Serial No: 534

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.14 | 0.12 | 0.02 |
| Low-Level Gas | 51.61 | 51.23 | 51.00 | 0.23 |
| Span Gas | 80.58 | 79.85 | 80.01 | 0.16 |

CO ANALYZER Model: TELEDYNE API T300M
Span (ppm) : 100
Serial No: 844

| | Cylinder Value (ppm) | Initial Analyzers Calibration Response (ppm) | Final Analyzers Calibration Response (ppm) | Difference (Percent of Span) |
|---------------|----------------------|--|--|------------------------------|
| Zero Gas | 0.00 | 0.07 | 0.15 | 0.06 |
| Low-Level Gas | 50.31 | 50.78 | 50.66 | 0.12 |
| Span Gas | 80.93 | 81.23 | 81.34 | 0.11 |

Calibrated by

(Mr. Anusut Moungpak)

Environmental Field Scientist (2)

FORM NO. P 06-082 REVISION NO. 2 ISSUE DATE 3/8/19

ALS Laboratory Group



SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client: GLOW ENERGY PCL
Date: 19 Apr 23
O₂ ANALYZER Cylinder Conc. (%) : 18.17
Span (%) : 25
Location: HRSG B2
Test Operator: Anusut M.

| | O ₂ Analyzer Calibration Response | Initial Values System Calibration Response | System Cal Bias (% of Span) | Final Values System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|--|--|-----------------------------|--|-----------------------------|-------------------|
| Zero Gas | 0.05 | 0.12 | 0.28 | 0.08 | 0.12 | 0.16 |
| Upscale Gas | 15.88 | 16.00 | 0.48 | 16.13 | 1.00 | 0.52 |

NO_x ANALYZER Cylinder Conc. (ppm) : 80.43
Span (ppm) : 100

| | NO _x Analyzer Calibration Response | Initial Values System Calibration Response | System Cal Bias (% of Span) | Final Values System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|---|--|-----------------------------|--|-----------------------------|-------------------|
| Zero Gas | 0.12 | 0.11 | 0.01 | 0.13 | 0.01 | 0.02 |
| Upscale Gas | 80.79 | 80.00 | 0.79 | 79.58 | 1.21 | 0.42 |

SO₂ ANALYZER Cylinder Conc. (ppm) : 80.58
Span (ppm) : 100

| | SO ₂ Analyzer Calibration Response | Initial Values System Calibration Response | System Cal Bias (% of Span) | Final Values System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|---|--|-----------------------------|--|-----------------------------|-------------------|
| Zero Gas | 0.14 | 0.08 | 0.06 | 0.05 | 0.09 | 0.03 |
| Upscale Gas | 79.85 | 79.55 | 0.30 | 79.99 | 0.14 | 0.44 |

CO ANALYZER Cylinder Conc. (ppm) : 80.83
Span (ppm) : 100

| | CO Analyzer Calibration Response | Initial Values System Calibration Response | System Cal Bias (% of Span) | Final Values System Calibration Response | System Cal Bias (% of Span) | Drift (% of Span) |
|-------------|----------------------------------|--|-----------------------------|--|-----------------------------|-------------------|
| Zero Gas | 0.07 | 0.05 | 0.02 | 0.13 | 0.06 | 0.08 |
| Upscale Gas | 81.23 | 81.00 | 0.23 | 80.88 | 0.35 | 0.12 |

Calibrated by

(Mr. Anusut Moungpak)

Environmental Field Scientist (2)

FORM NO. P 06-082 REVISION NO. 2 ISSUE DATE 3/8/19

ALS Laboratory Group



EMISSION TEST RESULT

| | | | |
|--|--------------------|---------------|-----------|
| Client | GLOW ENERGY PCL. | Run # | 1 |
| Date | 19 Apr 23 | Location | HR80 82 |
| Start Time | 13:25 | Test Operator | Anuwat M. |
| SO ₂ Analyzer Model | TELEDYNE API T100H | Finish Time | 13:45 |
| NO _x /O ₂ Analyzer Model | TELEDYNE API T200H | Serial No. | 534 |
| CO/CO ₂ Analyzer Model | TELEDYNE API T300M | Serial No. | 822 |
| | | Serial No. | 844 |

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 13:25 | 14.06 | 4.01 | 22.06 | 0.16 | 0.85 | |
| 13:26 | 14.05 | 4.00 | 22.22 | 0.16 | 0.86 | |
| 13:27 | 14.05 | 4.00 | 22.60 | 0.16 | 0.89 | |
| 13:28 | 14.05 | 4.00 | 22.61 | 0.16 | 0.86 | |
| 13:29 | 14.06 | 4.02 | 22.70 | 0.19 | 0.87 | |
| 13:30 | 14.04 | 3.96 | 22.80 | 0.19 | 1.09 | |
| 13:31 | 14.03 | 4.00 | 22.81 | 0.19 | 0.96 | |
| 13:32 | 14.04 | 4.00 | 22.78 | 0.17 | 0.93 | |
| 13:33 | 14.04 | 4.00 | 22.74 | 0.17 | 0.91 | |
| 13:34 | 14.05 | 4.01 | 22.78 | 0.17 | 0.94 | |
| 13:35 | 14.04 | 4.01 | 20.24 | 0.18 | 0.95 | |
| 13:36 | 14.04 | 4.00 | 20.21 | 0.18 | 0.95 | |
| 13:37 | 14.04 | 4.00 | 20.16 | 0.18 | 0.98 | |
| 13:38 | 14.03 | 4.00 | 20.17 | 0.17 | 0.90 | |
| 13:39 | 14.04 | 4.01 | 20.17 | 0.17 | 0.91 | |
| 13:40 | 14.03 | 4.01 | 20.20 | 0.17 | 0.93 | |
| 13:41 | 14.03 | 4.01 | 20.23 | 0.16 | 0.88 | |
| 13:42 | 14.05 | 4.00 | 20.17 | 0.17 | 0.87 | |
| 13:43 | 14.03 | 4.00 | 20.14 | 0.19 | 0.91 | |
| 13:44 | 14.03 | 4.01 | 20.28 | 0.17 | 0.95 | |
| 13:45 | 14.04 | 4.02 | 20.36 | 0.18 | 0.92 | |
| Average | 14.04 | 4.01 | 21.36 | 0.17 | 0.92 | |

Anuwat M.

(Mr. Anuwat Mungpak)

Environmental Field Scientist (2)

FORM E-2 (REV. 1) REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group



EMISSION TEST RESULT

| | | | |
|--|--------------------|---------------|-----------|
| Client | GLOW ENERGY PCL. | Run # | 2 |
| Date | 19 Apr 23 | Location | HR80 82 |
| Start Time | 13:48 | Test Operator | Anuwat M. |
| SO ₂ Analyzer Model | TELEDYNE API T100H | Finish Time | 14:06 |
| NO _x /O ₂ Analyzer Model | TELEDYNE API T200H | Serial No. | 534 |
| CO/CO ₂ Analyzer Model | TELEDYNE API T300M | Serial No. | 822 |
| | | Serial No. | 844 |

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 13:48 | 14.05 | 4.03 | 20.33 | 0.21 | 0.89 | |
| 13:49 | 14.04 | 4.02 | 20.31 | 0.19 | 0.92 | |
| 13:50 | 14.04 | 4.02 | 20.30 | 0.19 | 0.95 | |
| 13:51 | 14.04 | 4.02 | 20.48 | 0.21 | 1.04 | |
| 13:52 | 14.03 | 4.00 | 20.59 | 0.16 | 1.07 | |
| 13:53 | 14.03 | 4.00 | 20.71 | 0.19 | 0.97 | |
| 13:54 | 14.03 | 4.02 | 20.84 | 0.18 | 0.90 | |
| 13:55 | 14.04 | 4.02 | 21.11 | 0.18 | 0.88 | |
| 13:56 | 14.03 | 4.01 | 21.19 | 0.17 | 0.89 | |
| 13:57 | 14.03 | 4.01 | 21.16 | 0.20 | 0.96 | |
| 13:58 | 14.04 | 4.01 | 21.12 | 0.18 | 1.03 | |
| 13:59 | 14.05 | 4.01 | 21.15 | 0.17 | 0.94 | |
| 14:00 | 14.05 | 4.01 | 21.22 | 0.19 | 0.91 | |
| 14:01 | 14.05 | 4.02 | 21.26 | 0.17 | 0.86 | |
| 14:02 | 14.05 | 4.01 | 21.33 | 0.17 | 0.87 | |
| 14:03 | 14.05 | 4.02 | 21.39 | 0.19 | 0.92 | |
| 14:04 | 14.05 | 4.02 | 21.94 | 0.17 | 0.90 | |
| 14:05 | 14.07 | 4.02 | 21.60 | 0.17 | 0.89 | |
| 14:06 | 14.06 | 4.01 | 21.53 | 0.17 | 0.87 | |
| 14:07 | 14.05 | 4.00 | 21.76 | 0.17 | 0.87 | |
| 14:08 | 14.05 | 4.00 | 21.95 | 0.17 | 0.85 | |
| Average | 14.06 | 4.02 | 21.10 | 0.18 | 0.92 | |

Anuwat M.

(Mr. Anuwat Mungpak)

Environmental Field Scientist (2)

FORM E-2 (REV. 1) REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

45/1-45/1-1 Srinthorn Rd., Bangburmu, Banglud Bangkok 10700 THAILAND.
Tel: 0-2433-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



NCC-TIS-17025
CALIBRATION 0394

Cert. No.: ACC22023
Pages: 1 of 3

Calibration Certificate

Equipment: SOUND CALIBRATOR
Manufacturer: RION
Model: NC-74
Serial No.: 34178123
ID No.: RYG F80215

Condition As Found: GOOD

Customer: ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHUWAENG PHATTANAKAN, KHUET SUAN 1 LUANG,
BANGKOK, 10250 THAILAND.

Location: -
Ambient Temperature: (23.0 ± 3) °C
Pressure: (101.3 ± 3) hPa
Relative Humidity: (50.0 ± 20) %

Received Date: 22 AUGUST 2022
Calibration Date: 31 AUGUST 2022
Date of Issue: 02 SEPTEMBER 2022

Calibrated by: Nathakorn Pisutapassan

Approved by:
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QI-TS12-01-044-021668



EMISSION TEST RESULT

| | | | |
|--|--------------------|---------------|-----------|
| Client | GLOW ENERGY PCL. | Run # | 3 |
| Date | 19 Apr 23 | Location | HR80 82 |
| Start Time | 14:07 | Test Operator | Anuwat M. |
| SO ₂ Analyzer Model | TELEDYNE API T100H | Finish Time | 14:27 |
| NO _x /O ₂ Analyzer Model | TELEDYNE API T200H | Serial No. | 534 |
| CO/CO ₂ Analyzer Model | TELEDYNE API T300M | Serial No. | 822 |
| | | Serial No. | 844 |

| Time (min) | O ₂ (%) | CO ₂ (%) | NO _x (ppm) | SO ₂ (ppm) | CO (ppm) | Remark |
|------------|--------------------|---------------------|-----------------------|-----------------------|----------|--------|
| 14:07 | 14.04 | 4.01 | 22.11 | 0.17 | 0.91 | |
| 14:08 | 14.07 | 4.01 | 22.11 | 0.18 | 0.87 | |
| 14:09 | 14.07 | 4.01 | 22.04 | 0.18 | 0.90 | |
| 14:10 | 14.07 | 4.00 | 21.98 | 0.18 | 0.87 | |
| 14:11 | 14.06 | 3.99 | 22.06 | 0.17 | 0.89 | |
| 14:12 | 14.05 | 4.00 | 22.22 | 0.14 | 0.99 | |
| 14:13 | 14.05 | 4.00 | 22.36 | 0.18 | 0.87 | |
| 14:14 | 14.07 | 4.01 | 22.45 | 0.17 | 0.93 | |
| 14:15 | 14.07 | 4.00 | 22.51 | 0.16 | 0.87 | |
| 14:16 | 14.05 | 4.00 | 22.55 | 0.17 | 0.88 | |
| 14:17 | 14.05 | 4.00 | 22.58 | 0.18 | 0.86 | |
| 14:18 | 14.04 | 4.00 | 22.52 | 0.19 | 0.85 | |
| 14:19 | 14.04 | 4.03 | 22.49 | 0.18 | 0.90 | |
| 14:20 | 14.05 | 4.02 | 22.60 | 0.21 | 0.87 | |
| 14:21 | 14.05 | 4.01 | 22.89 | 0.21 | 0.95 | |
| 14:22 | 14.05 | 4.01 | 22.73 | 0.22 | 1.06 | |
| 14:23 | 14.05 | 4.01 | 22.72 | 0.17 | 1.06 | |
| 14:24 | 14.05 | 4.00 | 22.66 | 0.18 | 0.97 | |
| 14:25 | 14.04 | 4.01 | 22.58 | 0.16 | 0.77 | |
| 14:26 | 14.04 | 4.01 | 22.60 | 0.19 | 0.84 | |
| 14:27 | 14.05 | 4.01 | 22.52 | 0.22 | 0.84 | |
| Average | 14.05 | 4.01 | 22.44 | 0.18 | 0.90 | |

Anuwat M.

(Mr. Anuwat Mungpak)

Environmental Field Scientist (2)

FORM E-2 (REV. 1) REVISION NO. 2 ISSUE DATE: 30/01/19

ALS Laboratory Group

Continuation of Calibration Certificate

Cert. No. : ACC22023
Job No. : VC65AC0077
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|-----------|------------|-----------------|-----------|
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |
| Audio Analyzer | AVR-3360A | V744B6069 | EF-0010-22 | 07-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC22023
Job No. : VC65AC0077
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

| Specified sound pressure level (dB) | Measured value (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit (dB) |
|-------------------------------------|---------------------|---------------------|------------------|----------------------|
| 94 | 94.04 | 0.04 | 0.14 | 0.40 |

2. Frequency

| Specified Frequency (Hz) | Measured value (Hz) | Deviated value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------------|---------------------|--------------------|-----------------|---------------------|
| 1000 | 1001.5 | 0.1 | 0.1 | 1.0 |

3. Total distortion

| Measured value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------|-----------------|---------------------|
| 1.70 | 0.10 | 3.0 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %.

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND.
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23082
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734220 / 145272 / 34370
ID No. : RYG_FS0026

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nithakorn Pistupaisan

Approved by :

T. Petchurui
(Thanakul Petchurui)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|-----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--------------------------------|---------------------|----------------|-----------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|---------------------|
| 15.6 |

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

| Frequency Weighting | Measured value (dB) |
|---------------------|---------------------|
| A - weight | 12.0 |
| C - weight | 18.3 |
| Flat | 24.1 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.2 | 0.2 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | -1.6 | -1.5 | -1.5 | ±5.0 |

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | -0.1 | -0.1 | -0.1 | ±2.0 |
| 125 | -0.1 | 0.0 | -0.1 | ±1.5 |
| 250 | 0.0 | -0.1 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.0 | 0.0 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.3 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A - weight | 94.0 | 94.1 | 0.1 | ± 0.3 |

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T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.1 | 0.1 | ± 1.1 |
| 134.0 | 134.1 | 0.1 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.1 | 0.1 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.1 | 0.1 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|------------------------|---------------------|---------------------|------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------|------------------------------|-------|------------------------|---------------------|---------------------|------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5; -5.0 |
| | 2 | 8 | 117.0 | 116.9 | -0.1 | 1.0; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 107.9 | -0.1 | 1.5; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| | 0.25 | 1 | 99.0 | 98.8 | -0.2 | 1.5; -5.0 |
| SEL | 2 | 8 | 108.0 | 107.9 | -0.1 | 1.0; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, L _{peak} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|--|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.3 | -0.1 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.5 | -0.1 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd., Bangbunru, Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23041
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42; Microphone UC-52 / Pre-amplifier NH-24
Serial No. : 00734221 / 145286 / 34371
ID No. : RYG_FS0027

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KIWAENG PHATTANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3.1) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisurpaisan

Approved by : T. Petch
(Thanakul Pisichuraj)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

SITHIPORN SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with anechoic chamber and Reference Standard Instruments.

For test results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL-BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL-BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY60024273 | EEL-BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KA1 | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

T. Petch

Summary of Measurement Result:

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long-term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

T. Petch

Result of calibration:

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--------------------------------|---------------------|----------------|-----------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|---------------------|
| 17.1 |

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

| Frequency Weighting | Measured value (dB) |
|---------------------|---------------------|
| A-weight | 13.4 |
| C-weight | 19.6 |
| Flat | 25.5 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.4 | 0.4 | 0.4 | ±1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ±1.0 |
| 8000 | 1.5 | 1.6 | 1.6 | ±5.0 |

QF-TS12-04-04-020664

T. Petch

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| A-weight | 94.0 | 0.0 | - |
| C-weight | 94.0 | 0.0 | ±0.2 |
| Flat | 94.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ±0.1 |
| Leq | 94.0 | 0.0 | ±0.1 |

6. Long-term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 94.0 | 94.0 | 0.0 | ±0.3 |

QF-TS12-04-04-020664

T. Petch

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 137.0 | 137.0 | 0.0 | ±1.1 |
| 136.0 | 136.0 | 0.0 | ±1.1 |
| 135.0 | 135.0 | 0.0 | ±1.1 |
| 134.0 | 134.0 | 0.0 | ±1.1 |
| 133.0 | 133.0 | 0.0 | ±1.1 |
| 132.0 | 132.0 | 0.0 | ±1.1 |
| 131.0 | 131.0 | 0.0 | ±1.1 |
| 129.0 | 129.0 | 0.0 | ±1.1 |
| 124.0 | 124.0 | 0.0 | ±1.1 |
| 119.0 | 119.0 | 0.0 | ±1.1 |
| 114.0 | 114.0 | 0.0 | ±1.1 |
| 109.0 | 109.0 | 0.0 | ±1.1 |
| 104.0 | 104.0 | 0.0 | ±1.1 |
| 99.0 | 99.0 | 0.0 | ±1.1 |
| 94.0 | 94.0 | 0.0 | ±1.1 |
| 89.0 | 89.0 | 0.0 | ±1.1 |
| 84.0 | 84.0 | 0.0 | ±1.1 |
| 79.0 | 79.0 | 0.0 | ±1.1 |
| 74.0 | 74.0 | 0.0 | ±1.1 |
| 69.0 | 69.0 | 0.0 | ±1.1 |
| 64.0 | 64.0 | 0.0 | ±1.1 |
| 59.0 | 59.0 | 0.0 | ±1.1 |
| 54.0 | 54.0 | 0.0 | ±1.1 |
| 49.0 | 49.0 | 0.0 | ±1.1 |
| 44.0 | 44.0 | 0.0 | ±1.1 |
| 39.0 | 38.9 | -0.1 | ±1.1 |
| 34.0 | 33.9 | -0.1 | ±1.1 |
| 30.0 | 29.9 | -0.1 | ±1.1 |
| 29.0 | 28.9 | -0.1 | ±1.1 |
| 28.0 | 27.9 | -0.1 | ±1.1 |
| 27.0 | 26.9 | -0.1 | ±1.1 |
| 26.0 | 25.9 | -0.1 | ±1.1 |
| 25.0 | 24.8 | -0.2 | ±1.1 |

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|------------------------|---------------------|---------------------|------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------|------------------------------|-------|------------------------|---------------------|---------------------|------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| SEL | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, L _{peak} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|--|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.0 | -0.4 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23041
Job No. : VC66AC0024
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | 0.0 | ±1.5 |
| 89.6 | 89.6 | | |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd, Bangbunru, Bangkok 10700 THAILAND.
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22115
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734223 / 157777 / 22653
ID No.: RYG_FS0029

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 17 MAY 2022
Calibration Date : 24-27 MAY 2022
Date of Issue : 30 MAY 2022

Calibrated by : Natthakorn Pisutpaisan

Approved by :

(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL_BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL_BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL_BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EE-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 29779001 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KA1 | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020064

T. R. R. R.

Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--------------------------------|---------------------|----------------|-----------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|---------------------|
| 18.0 |

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

| Frequency Weighting | Measured value (dB) |
|---------------------|---------------------|
| A - weight | 13.8 |
| C - weight | 20.3 |
| Flat | 25.8 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | Acceptance Limits |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | |
| 125 | 0.7 | 0.7 | 0.7 | ± 1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 8000 | -1.5 | -1.5 | -1.5 | ± 5.0 |

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T. R. R. R.

Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | Acceptance Limits |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | |
| 63 | -0.1 | -0.2 | -0.1 | ±2.0 |
| 125 | -0.1 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.0 | 0.0 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |

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T. R. R. R.

Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 132.9 | -0.1 | ± 1.1 |
| 132.0 | 131.9 | -0.1 | ± 1.1 |
| 131.0 | 130.9 | -0.1 | ± 1.1 |
| 129.0 | 128.9 | -0.1 | ± 1.1 |
| 124.0 | 123.9 | -0.1 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 28.0 | 0.0 | ± 1.1 |
| 27.0 | 27.0 | 0.0 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.9 | -0.1 | ± 1.1 |

QF-TS12-04-04-020064

T. R. R. R.

Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|------------------------|---------------------|---------------------|------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------|------------------------------|-------|------------------------|---------------------|---------------------|------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 116.9 | -0.1 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.8 | -0.2 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, Lepeak (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|-----------------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.8 | -0.6 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |

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Continuation of Calibration Certificate

Cert. No. : ACL22115
Job No. : VC65AC0060
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | 0.0 | ±1.5 |
| 89.6 | 89.6 | | |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthon Rd., Bangbunru, Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2435-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23048
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 01222724 / 143842 / 22771
ID No. : RYG_FS0023

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisopaisan

Approved by :

T. Petchuraj
(Thanakul Petchuraj)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL_BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL_BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL_BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAJ | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

- 3.1 National Institute of Metrology (Thailand),
3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--------------------------------|---------------------|----------------|-----------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|---------------------|
| 15.4 |

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

| Frequency Weighting | Measured value (dB) |
|---------------------|---------------------|
| A - weight | 11.2 |
| C - weight | 17.6 |
| Flat | 23.4 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.2 | 0.2 | ±1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ±1.0 |
| 8000 | -0.8 | -0.8 | -0.7 | ±5.0 |

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P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | -0.1 | -0.1 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ±0.2 |
| Flat | 94.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ±0.1 |
| Leq | 94.0 | 0.0 | ±0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ±0.3 |

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 137.0 | 137.0 | 0.0 | ±1.1 |
| 136.0 | 136.0 | 0.0 | ±1.1 |
| 135.0 | 135.0 | 0.0 | ±1.1 |
| 134.0 | 134.0 | 0.0 | ±1.1 |
| 133.0 | 133.0 | 0.0 | ±1.1 |
| 132.0 | 132.0 | 0.0 | ±1.1 |
| 131.0 | 131.0 | 0.0 | ±1.1 |
| 129.0 | 129.0 | 0.0 | ±1.1 |
| 124.0 | 124.0 | 0.0 | ±1.1 |
| 119.0 | 119.0 | 0.0 | ±1.1 |
| 114.0 | 114.0 | 0.0 | ±1.1 |
| 109.0 | 109.0 | 0.0 | ±1.1 |
| 104.0 | 104.0 | 0.0 | ±1.1 |
| 99.0 | 99.0 | 0.0 | ±1.1 |
| 94.0 | 94.0 | 0.0 | ±1.1 |
| 89.0 | 89.0 | 0.0 | ±1.1 |
| 84.0 | 84.0 | 0.0 | ±1.1 |
| 79.0 | 79.0 | 0.0 | ±1.1 |
| 74.0 | 74.0 | 0.0 | ±1.1 |
| 69.0 | 69.0 | 0.0 | ±1.1 |
| 64.0 | 64.0 | 0.0 | ±1.1 |
| 59.0 | 59.0 | 0.0 | ±1.1 |
| 54.0 | 53.9 | -0.1 | ±1.1 |
| 49.0 | 48.9 | -0.1 | ±1.1 |
| 44.0 | 43.9 | -0.1 | ±1.1 |
| 39.0 | 38.9 | -0.1 | ±1.1 |
| 34.0 | 33.9 | -0.1 | ±1.1 |
| 30.0 | 29.9 | -0.1 | ±1.1 |
| 29.0 | 28.8 | -0.2 | ±1.1 |
| 28.0 | 27.9 | -0.1 | ±1.1 |
| 27.0 | 26.8 | -0.2 | ±1.1 |
| 26.0 | 25.9 | -0.1 | ±1.1 |
| 25.0 | 24.8 | -0.2 | ±1.1 |

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
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8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|------------------------|---------------------|---------------------|------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------|------------------------------|-------|------------------------|---------------------|---------------------|------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5; -3.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5; -5.0 |
| SEL | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C' sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, L _{peak} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|--|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.8 | -0.6 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |

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Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0024
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.7 | 0.1 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd., Bangbunruy, Bangplud Bangkok 10700 THAILAND.
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23077
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00233184 / 144837 / 23232
ID No. : RYG_FS0025

Condition As Found : GOOD

Customer : A.I.S LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Naitakorn Pisutpaisan

Approved by :

T. Petchum
(Thanakul Petchum)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|-----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL-BP_04/02/65 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL-BP_03/02/65 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY60024273 | EEL-BP_05/02/65 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAJ | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration, for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long-term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

T. R. R.

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--------------------------------|---------------------|----------------|-----------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|---------------------|
| 14.2 |

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

| Frequency Weighting | Measured value (dB) |
|---------------------|---------------------|
| A-weight | 10.8 |
| C-weight | 17.1 |
| Flat | 22.8 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.2 | 0.2 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | -1.0 | -0.9 | -0.8 | ±5.0 |

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T. R. R.

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.1 | ±2.0 |
| 4000 | 0.0 | 0.1 | 0.1 | ±3.0 |
| 8000 | 0.1 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| A-weight | 94.0 | 0.0 | - |
| C-weight | 94.0 | 0.0 | ±0.2 |
| Flat | 94.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ±0.1 |
| Leq | 94.0 | 0.0 | ±0.1 |

6. Long-term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 94.0 | 94.1 | 0.1 | ±0.3 |

QF-TS12-04-04-020664

T. R. R.

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 137.0 | 137.0 | 0.0 | ±1.1 |
| 136.0 | 136.0 | 0.0 | ±1.1 |
| 135.0 | 135.0 | 0.0 | ±1.1 |
| 134.0 | 134.0 | 0.0 | ±1.1 |
| 133.0 | 133.0 | 0.0 | ±1.1 |
| 132.0 | 132.0 | 0.0 | ±1.1 |
| 131.0 | 131.0 | 0.0 | ±1.1 |
| 129.0 | 129.0 | 0.0 | ±1.1 |
| 124.0 | 124.0 | 0.0 | ±1.1 |
| 119.0 | 119.0 | 0.0 | ±1.1 |
| 114.0 | 114.0 | 0.0 | ±1.1 |
| 109.0 | 109.0 | 0.0 | ±1.1 |
| 104.0 | 104.0 | 0.1 | ±1.1 |
| 99.0 | 99.0 | 0.0 | ±1.1 |
| 94.0 | 94.0 | 0.0 | ±1.1 |
| 89.0 | 89.0 | 0.0 | ±1.1 |
| 84.0 | 84.0 | 0.0 | ±1.1 |
| 79.0 | 79.0 | 0.0 | ±1.1 |
| 74.0 | 74.0 | 0.0 | ±1.1 |
| 69.0 | 69.0 | 0.0 | ±1.1 |
| 64.0 | 64.0 | 0.0 | ±1.1 |
| 59.0 | 59.0 | 0.0 | ±1.1 |
| 54.0 | 54.0 | 0.0 | ±1.1 |
| 49.0 | 49.0 | 0.0 | ±1.1 |
| 44.0 | 44.0 | 0.0 | ±1.1 |
| 39.0 | 39.0 | 0.0 | ±1.1 |
| 34.0 | 34.0 | 0.0 | ±1.1 |
| 30.0 | 29.9 | -0.1 | ±1.1 |
| 29.0 | 29.0 | 0.0 | ±1.1 |
| 28.0 | 27.9 | -0.1 | ±1.1 |
| 27.0 | 27.0 | 0.0 | ±1.1 |
| 26.0 | 25.9 | -0.1 | ±1.1 |
| 25.0 | 24.9 | -0.1 | ±1.1 |

QF-TS12-04-04-020664

T. R. R.

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|------------------------|---------------------|---------------------|------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighing | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------|------------------------------|-------|------------------------|---------------------|---------------------|------------------------|
| Fast | 0.25 | 1 | 108.0 | 108.0 | 0.0 | 1.5; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, L _{peak} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|--|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.4 | 0.0 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------|---------------------|------------------------|
| Continuous | 133.0 | 132.9 | -0.1 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.5 | 89.7 | 0.2 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95%.

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Swinhornd Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
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Cert. No. : ACL22295
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Pre-amplifier NH-24
Serial No. : 00233183 / 144835 / 23230
ID No. : RYG_FS0024

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 2) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 07 DECEMBER 2022
Calibration Date : 16-20 DECEMBER 2022
Date of Issue : 21 DECEMBER 2022

Calibrated by : Nithakorn Pisutpaisan

Approved by :

T. Petch
(Thanakul Petchurui)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL-BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL-BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL-BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAJ | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--------------------------------|---------------------|----------------|-----------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|---------------------|
| 19.3 |

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

| Frequency Weighting | Measured value (dB) |
|---------------------|---------------------|
| A - weight | 14.8 |
| C - weight | 20.6 |
| Flat | 26.5 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | -0.1 | -0.1 | -0.1 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | 0.3 | 0.4 | 0.4 | ±5.0 |

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|----------------|--|----------|----------|-------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 53.9 | -0.1 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 43.9 | -0.1 | ± 1.1 |
| 39.0 | 38.9 | -0.1 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.8 | -0.2 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
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8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|------------------------|---------------------|---------------------|------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, T _b (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------|--|-------|------------------------|---------------------|---------------------|------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, L _{cpk} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.6 | -0.8 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|------------------------|---------------------|---------------------|------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |

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Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | 0.0 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 02-2435-8800 Fax: 02-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comNSC-TS12-105 17025
CALIBRATION 0354Cert. No. : ACC23005
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No. : 35002736
ID No. : RYG_PS0496

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KITWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 17 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nuthakorn Pitsitpaisan

Approved by :

(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|-----------|------------|----------------|-----------|
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL_BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL_BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY60024273 | EEL_BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KA1 | 34560495 | AA-3005-22 | 22-Feb-23 |
| Audio Analyzer | AVR-3360A | V744B6069 | EF-0010-22 | 07-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

- 1 National Institute of Metrology (Thailand).
- 2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Cert. No. : ACC23005
Job No. : VC66AC0024
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

| Specified sound pressure level (dB) | Measured value (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit (dB) |
|-------------------------------------|---------------------|---------------------|------------------|----------------------|
| 94 | 93.98 | -0.02 | 0.14 | 0.40 |

2. Frequency

| Specified Frequency (Hz) | Measured value (Hz) | Deviated value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------------|---------------------|--------------------|-----------------|---------------------|
| 1000 | 1000.0 | 0.0 | 0.1 | 1.0 |

3. Total distortion

| Measured value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------|-----------------|---------------------|
| 0.35 | 0.10 | 3.0 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k=2$ or any value following calculation, providing a level of confidence of approximately 95 %.

End of Calibration Certificate

QF-TS12-04-04-020664

451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22238
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623392 / 198639 / 26420
ID No. :

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 07 OCTOBER 2022
Calibration Date : 20-21 OCTOBER 2022
Date of Issue : 21 OCTOBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL-BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL-BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL-BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long-term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limits (dB) |
|--|-----------------------------|---------------------|--------------------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|--------------------------|
| 15.1 |

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

| Frequency Weighting | Measured value (dB) |
|------------------------|--------------------------|
| A - weight | 12.0 |
| C - weight | 18.4 |
| Flat | 24.4 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.1 | 0.1 | 0.1 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | 0.8 | 0.8 | 0.8 | ±5.0 |

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | -0.1 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-----------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display as final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 53.9 | -0.1 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 38.9 | -0.1 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.8 | -0.2 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |

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Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------|--------------------------------------|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, T _{peak} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|--|-----------------------------|--------------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.1 | -0.3 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22238
Job No. : VC65AC0089
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|-----------------------|--------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.5 | -0.1 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-------------------------------|-----------------------------|-----------------------|--------------------------|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664



451-451/1 Sirinthorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND.
Tel:0-2433-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com

Cert. No. : ACL23042
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900071 / 188464 / 01733
ID No.: RYG_TS0492

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KIJWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchural
(Tianakul Petchural)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|-------------------------|----------|------------|----------------|-----------|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL_BP_04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL_BP_03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL_BP_05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KA | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|------|------|------------------|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long-term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|--------------------------|
| 14.6 |

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

| Frequency Weighting | Measured value (dB) |
|------------------------|--------------------------|
| A - weight | 11.6 |
| C - weight | 17.9 |
| Flat | 23.9 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.2 | 0.2 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | 0.3 | 0.4 | 0.4 | ±5.0 |

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency-weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-----------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SUM Display at initial (dB) | SUM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 53.9 | -0.1 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 43.9 | -0.1 | ± 1.1 |
| 39.0 | 38.9 | -0.1 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.8 | -0.2 | ± 1.1 |
| 26.0 | 25.8 | -0.2 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------|--------------------------------------|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| SEL | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

10. Peak C' sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, L _{peak} (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|--|-----------------------------|--------------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.3 | -0.1 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |

QF-TS13-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23042
Job No. : VC66AC0024
Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------------|-------------------------|---------------------|------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.3 | 89.6 | 0.1 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---------------------|-----------------------------|---------------------------|---------------------|------------------------|
| A-weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-1512-04-04-03064

CERTIFICATE OF CALIBRATION

Certificate No. : CL-013-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018312
ID No: RYG_FS0357

Customer
Name: ALS laboratory group (thailand) Co., Ltd.
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Received date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 06 Feb 2023

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No: 657682-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (55±15)%

Calibration Procedure
The temperature calibration was done by In-House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

Calibrated by
☒ Mr. Sorawit Thacholad
☐ Miss Jitraporn Lertsomphol



Approved Signature:
Mr. Parinya Booncharoen
Calibration Department Manager

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

Certificate No. : CL-013-66
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021464.
Dimension: Diameter 14 mm, Length 170 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 60 | 20.061 | 20.0 | 0.1 | 0.099 |
| 60 | 25.047 | 25.0 | 0.0 | 0.099 |
| 60 | 30.040 | 30.0 | 0.0 | 0.099 |
| 60 | 35.034 | 35.0 | 0.0 | 0.099 |
| 60 | 40.020 | 40.0 | 0.0 | 0.099 |

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021263.
Dimension: Diameter 14 mm, Length 150 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 70 | 20.060 | 20.1 | 0.0 | 0.099 |
| 70 | 25.048 | 25.0 | 0.0 | 0.099 |
| 70 | 30.040 | 29.9 | -0.1 | 0.099 |
| 70 | 35.034 | 34.9 | -0.1 | 0.099 |
| 70 | 40.021 | 39.8 | -0.2 | 0.099 |

Table 3: This equipment was connected with Globe thermometer probe Model: TP3275.2 S/N: 18020495.
Dimension: Diameter 8 mm, Length 170 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 110 | 20.060 | 20.1 | 0.0 | 0.24 |
| 110 | 25.047 | 25.0 | 0.0 | 0.099 |
| 110 | 30.040 | 30.0 | 0.0 | 0.099 |
| 110 | 35.034 | 35.0 | 0.0 | 0.099 |
| 110 | 40.020 | 40.0 | 0.0 | 0.099 |

UUC* : Unit Under Calibration

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

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Certificate No. : CL-017-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 15006715
ID No: RYG_FS0220

Customer
Name: ALS laboratory group (thailand) Co., Ltd.
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Received date: 23 Jan 2023
Calibration date: 03 Feb 2023
Issue date: 06 Feb 2023

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No: 657682-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No: 671407-00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (55±15)%

Calibration Procedure
The temperature calibration was done by In-House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0034-22, Certificate number: ER-0092-
22

Calibrated by
☒ Mr. Sorawit Thacholad
☐ Miss Jitraporn Lertsomphol



Approved Signature:
Mr. Parinya Booncharoen
Calibration Department Manager

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



63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapra, Bangkokyal, Bangkok 10600 Thailand
Tel: (66) 02-6680812813 Fax: (66) 02-6680860 www.jiranasale.com



Certificate No.: CL-017-68
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 17022563.
Dimension: Diameter 14 mm, Length 170 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 80 | 20.062 | 20.0 | -0.1 | 0.099 |
| 60 | 25.054 | 25.0 | -0.1 | 0.099 |
| 60 | 30.048 | 30.0 | 0.0 | 0.099 |
| 60 | 35.034 | 35.0 | -0.1 | 0.16 |
| 60 | 40.019 | 39.9 | -0.1 | 0.099 |

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15018507.
Dimension: Diameter 14 mm, Length 150 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 70 | 20.061 | 20.2 | 0.1 | 0.099 |
| 70 | 25.053 | 25.1 | 0.0 | 0.099 |
| 70 | 30.043 | 30.0 | 0.0 | 0.099 |
| 70 | 35.031 | 35.0 | 0.0 | 0.099 |
| 70 | 40.014 | 39.9 | -0.1 | 0.099 |

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20018552.
Dimension: Diameter 8 mm, Length 170 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|----------------------|-----------------------|------------------|------------|------------------|
| 110 | 20.061 | 20.0 | -0.1 | 0.099 |
| 110 | 25.055 | 25.1 | 0.0 | 0.099 |
| 110 | 30.054 | 30.1 | 0.0 | 0.10 |
| 110 | 35.033 | 35.1 | 0.1 | 0.099 |
| 110 | 40.011 | 40.1 | 0.1 | 0.099 |

UUC*: Unit Under Calibration

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

* End of Certificate *



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
144/4 PATTANAKARN ROAD SOI 14, SUANLUANG SUANLUNG BANGKOK 10250
TEL: 0-2717-9002 FAX: 0-2718-9884



Cert.No.: 22CH1733
Page.: 1 of 3

Certificate of Calibration

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenExcellence
Serial No.: B834291445
ID No.: RYG_EN0152
Condition As/Received: Used Item
Received Date: 21 December 2022
Calibration Date: 22 December 2022
Reference: 2212-0602DSC-1
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5 T.Maenam Khu.
A.Pluakdaeng, Rayong 21140, Thailand

Ambient Temperature: (25 ± 2.5) °C
Relative Humidity: (50 ± 15) %
Calibration Procedure: in-house method:
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by: Warakorn Lemragtrakul

Approved by:
Approved Signatory

(/) Malee Budkrua
() Sathip Meangmai
() Warakorn Lemragtrakul

Issue Date: 26 December 2022
The Uncertainties are for a confidence probability of approximately 95%.

This certificate may not be reproduced without the full consent of the provider.
Approval of the National Accreditation Board (ANAB) is required for the use of this certificate.

A 0048758



Cert.No.: 22CH1733
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

| Instrument | Serial No. | ID No. | Cert. No. | Due Date |
|--------------------------------|------------|----------|-----------|-------------|
| 1) Document Process Calibrator | 54030049 | 130RC116 | 22E2769 | 24 Aug 2023 |
| 2) Ref. Standard Thermometer | 4982054 | 110RC044 | 2211306 | 27 Oct 2023 |

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

2. Certified Reference Materials

The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AN-1835

| Buffer Solution | Manufacturer | Lot No. | Exp. date |
|-----------------|--------------|---------|--------------|
| pH 4.008 | CPA chem | 826588 | 09 July 2024 |
| pH 6.867 | CPA chem | 823322 | 20 June 2023 |
| pH 10.008 | CPA chem | 826590 | 09 July 2023 |

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

Calibration Results

Function: mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

| Unit Under Calibration | Nominal Value | Standard Voltage Input | Actual Reading | Uncertainty of Measurement | Coverage factor |
|------------------------|---------------|------------------------|----------------|----------------------------|-----------------|
| | pH | mV | mV | (mV) | k |
| pH Meter | 4.000 | 177.48 | 177.3 | 0.058 | 2.00 |
| S/N: 8834291445 | 7.000 | 0.00 | -0.1 | 0.058 | 2.00 |
| | 10.000 | -177.48 | -177.5 | 0.058 | 2.00 |



Cert.No.: 22CH1733
Page.: 3 of 3

Calibration Results

Function: pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

| Unit Under Calibration | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH measurement (±) | Coverage factor k |
|------------------------|-----------------------------|-------------------|------------------------|-----------------------------------|-------------------|
| pH Electrode | 4.008 | 4.011 | 185.2 | 0.0052 | 2.06 |
| S/N: 1475518 | 6.867 | 6.990 | 10.4 | 0.0088 | 2.00 |
| | 10.008 | 10.014 | -166.5 | 0.0072 | 2.00 |

Function: Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe:

Model: InLab Expert Pro-ISM
Serial No.: 1475518

Dimension of probe:

Length: 120 mm
Diameter: 12 mm
Immersion Depth: 100 mm

| Calibration Point (°C) | Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty of measurement (± °C) | Coverage factor k |
|------------------------|---------------------------|-------------------|------------|-----------------------------------|-------------------|
| 25.0 | 25.001 | 24.9 | -0.101 | 0.13 | 2.00 |

Remark: - UUC* = Unit Under Calibration

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

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Certificate of Calibration

Certificate No.: 22E4098
Page: 1 of 2

Equipment: pH Meter
Manufacturer: Matter Toledo
Model: SevenExcellence
Serial No.: B534291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 21 December 2022
Calibration Date: 23 December 2022
Reference: 2212-000205C
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 10) %
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator

Condition of this result of calibration

1 Reference standards instruments

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|-----------------------------|-------|------------|-----------------|-------------|
| 1) Multi-Product Calibrator | 5900A | 8315011 | 22E1431 | 05 May 2023 |

2) The result of calibration was made on requested all the points specified by customer.
3) This certificate is valid only to the item calibrated on date and place of calibration.
4) This Calibration is traceable to the international System of Unit maintained at:-
National Institute of Metrology Thailand (NIMT)

Calibrated by: Wuthareepong Wongchulane
Issue Date: 25 December 2022

Approved Signatory

(Signature)
(Signature)
(Signature)

H 0304803



Cert. No.: 22E4098
Page: 2 of 2

Result of calibration - (*) Without adjustment () After adjustment

| Function: DC voltage measurement | Range: 2000 mV | Standard Value | UUC* Reading | Error | Uncertainty |
|----------------------------------|----------------|----------------|--------------|--------|-------------|
| | | (mV) | (mV) | (mV) | (± μV) |
| | | -200.0000 | -200.0 | 0.0 | 72 |
| | | -150.0000 | -150.0 | 0.0 | 69 |
| | | -100.0000 | -100.0 | 0.0 | 65 |
| | | -50.0000 | -50.0 | 0.0 | 62 |
| | | 0.0000 | 0.0 | 0.0 | 58 |
| | | 50.0000 | 50.0 | 0.0 | 62 |
| | | 100.0000 | 100.0 | 0.0 | 65 |
| | | 150.0000 | 150.0 | 0.0 | 69 |
| | | 200.0000 | 199.9 | -0.1 | 72 |

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

*UUC= Unit Under Calibration.

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8 1140616



Certificate of Calibration

Equipment: SPECTROPHOTOMETER
Model: DR8000
Serial No. (or ID.): 1627845 (RYG_EN0037)
Manufacturer: HACH
Condition: In Condition
Customer: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand.
Environment Condition: Temperature 23.1 °C ± 0.5
Humidity 65.4 %RH ± 3.2 %RH
Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch) (Wet Chemistry)
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand.
Calibration By: Mr. Chattaphon Fothong
Calibration Date: 27 September 2022
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 367-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 91416 and 91435
The standard for Photometric Certificate No. 91441 and 101068
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037

(Mr. Chattaphon Fothong)
Person in charge

(Mr. Thalekarn Pongnang)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard association.

The measurement uncertainty stated in the expanded uncertainty which is obtained from the assessed uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or compared. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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Phone: +66 2029 7000 Email: info.asia@dksh.com Website: www.dksh.com

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CAL-FM-C08-12: 30 Jul 2022



Certificate No.: C08220464 Page 2 of 3

Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of 816 at 2 nm and UUC at 2 nm

| Standard Wavelength | Unit Under Calibration | Correction | Uncertainty |
|---------------------|------------------------|------------|-------------|
| 418.61 | 418.4 | 0.21 | 0.14 |
| 536.80 | 536.7 | -0.04 | 0.14 |
| 637.90 | 638.2 | -0.32 | 0.14 |
| 748.48 | 748.6 | -0.32 | 0.14 |
| 807.03 | 807.4 | -0.37 | 0.13 |

Photometric Accuracy (Absorbance)

| Wavelength | Standard absorbance | Unit Under Calibration | Correction | Uncertainty |
|------------|---------------------|------------------------|------------|-------------|
| 420 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5605 | 0.563 | -0.0025 | 0.0045 |
| | 0.7334 | 0.737 | -0.0036 | 0.0045 |
| | 1.0534 | 1.057 | -0.0036 | 0.0045 |
| 440 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5503 | 0.553 | -0.0027 | 0.0045 |
| | 0.7179 | 0.720 | -0.0021 | 0.0045 |
| | 1.0312 | 1.034 | -0.0028 | 0.0045 |
| 465 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.6024 | 0.606 | -0.0036 | 0.0045 |
| | 0.8683 | 0.872 | -0.0037 | 0.0045 |
| | 0.9604 | 0.964 | -0.0036 | 0.0045 |
| 548.1 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5168 | 0.519 | -0.0022 | 0.0045 |
| | 0.8903 | 0.891 | -0.0007 | 0.0045 |
| | 0.9904 | 0.992 | -0.0016 | 0.0045 |
| 590 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5525 | 0.554 | -0.0016 | 0.0045 |
| | 0.7175 | 0.719 | -0.0005 | 0.0045 |
| | 1.0301 | 1.031 | -0.0008 | 0.0045 |
| 695 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.6367 | 0.636 | -0.0005 | 0.0045 |
| | 0.8847 | 0.885 | -0.0003 | 0.0045 |
| | 0.9823 | 0.983 | -0.0007 | 0.0045 |

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CAL-FM-C08-12: 30 Jul 2022

Calibration Results: Without Adjustment

| Photometric Accuracy (Absorbance) | | | | |
|-----------------------------------|----------------------|------------------------|----------------|-------------|
| Wavelength | Standard absorbance | Unit Under Calibration | Correction | Uncertainty |
| 235 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.7423 | 0.744 | -0.0017 | 0.0083 |
| 257 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.6609 | 0.661 | -0.0001 | 0.0084 |
| 313 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.2895 | 0.292 | -0.0025 | 0.0080 |
| 350 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.6381 | 0.638 | 0.0001 | 0.0080 |
| Stray light * | | | | |
| Standard: cut-off | UUC: Wavelength (nm) | UUC: Transmission (%) | Absorbance (A) | |
| 260.67 +/- 0.11 nm | 260.7 | 2.1 | 1.678 | |
| 391.84 +/- 0.11 nm | 391.9 | 1.7 | 1.770 | |
| Spectral Resolution * | | | | |
| Nominal Concentration 0.02 % w/v | Peak | Trough | Ratio | BBW |
| Standard Wavelength (nm) | 268.60 | 266.63 | 1.39 | 2.00 |
| UUC: Wavelength (nm) | 268.2 | 266.1 | | |
| Std Absorbance (A) | 0.4810 | 0.3178 | | |
| Absorbance (A) | 0.373 | 0.268 | | |

* Calibration Marked * Not TSI Accredited * In this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
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CAL-FM-C06-13-25 Jul 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR8000

หมายเลขเครื่อง: 1627845

| ตรวจสอบ (รับ) | | รายการตรวจวัด | ตรวจสอบ (ส่ง) | | หมายเหตุ |
|-------------------------------------|--------------------------|---|-------------------------------------|--------------------------|-------------------|
| 27 Sep 2022 | | | 27 Sep 2022 | | |
| ปกติ | ไม่ปกติ | | ปกติ | ไม่ปกติ | |
| General | | | | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1. ความสมบูรณ์เครื่อง | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกห้อง) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Switch) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. ปุ่มกด (Keypad) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 5. หน้าจอ (Display, Screen Contrast) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Spectrophotometer | | | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. แบตเตอรี่ (Battery Backup) >= 2.5 VDC | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. ตัวควบคุมความยาวคลื่น (Wavelength Control) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 8. ความยาวคลื่น (Wavelength Check) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 656.1 nm 656.1 nm |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9. แสงยูวี (UV < 3,000 hour) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 10. แสงที่มองเห็น (Visible < 5,000 hour) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 11. ช่องใส่ตัวอย่าง (Carousel Module) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| pH Meter and Conductivity Meter | | | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 12. อิเล็กโทรด (Electrode and Connection Cable) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 13. ระดับสารละลายใน Electrode (Level KCl) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 14. ฝาปิดป้องกัน Electrode (Dust Protection Hood) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 15. ขาตั้งอิเล็กโทรด (Stand) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Turbidimeter | | | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 16. ค่าความขุ่นในน้ำ (No Sample) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 17. เซลล์การวัดความขุ่น (>= 2.5 ไมครอน 3.0) | <input type="checkbox"/> | <input type="checkbox"/> | |
| Automatic Dilutor | | | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 18. แก้ว Piston Burettes | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 19. Function Rinsing and Dosing | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 20. ระบบท่อสายนำและอุปกรณ์ประกอบ | <input type="checkbox"/> | <input type="checkbox"/> | |

เงื่อนไขข้อบ่งชี้:

Mr. Chaituphon Fothong
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
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CAL-FM-R31-08-20 Jul 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD, SOI 18, SUANLUANG, SUANLUANG DISTRICT, BANGKOK 10250
TEL: 0-2717-3800 FAX: 0-2719-9484

Cert.No.: 22TW34
Page: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102796
ID No. : RYG_EN0032
Received Date : 11 February 2022
Test Date : 14 February 2022
Reference : Z202-0404USC-4
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Puakdaeng,
Rayong 21140, Thailand

Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-GHB
by Comparison Technique with Azide Modification Method

Tested by : Waleak Sinthuan
Approved by :
Approved Signatory

() Malee Bulkruta
(✓) Sathip Meangmal
() Warakorn Lemagatrakul

Issue Date : 18 February 2022

| | |
|---------------|---------|
| REVIEW BY | |
| APPROVED BY | |
| NEXT CAL DATE | 15/8/23 |



Cert.No.: 22TW34
Page: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 15E100454

| Titration Method (Azide Modification Method) (mg/L) | DO Meter Reading (mg/L) | Standard Deviation (mg/L) |
|---|-------------------------------|------------------------------|
| 8.02 | 8.02 | 0.0084 |

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

-000-

1094744

0281285



Equipment : Low Temp. incubator
Condition As-Received : Used Item
Reference : 2204-01460C-1
Result of Calibration : () Without Adjustment
Function of UUC : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM317
Page: 3 of 3

| Calibration Point (°C) | UUC* Setting (°C) | UUC* Reading (°C) | Temperature stability (± °C) | Temperature uniformity (°C) | Overall Variation (°C) | Uncertainty (± °C) | Coverage Factor k |
|------------------------|-------------------|-------------------|------------------------------|-----------------------------|------------------------|--------------------|-------------------|
| 20.0 | 20.0 | 20.0 | 0.022 | 0.20 | 0.22 | 0.30 | 2 |

| Calibration Point (°C) | Measured Temperature (°C) | | | | | | | | |
|------------------------|---------------------------|--------|--------|--------|--------|--------|--------|--------|----------|
| | Position | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 20.0 | 20.209 | 20.174 | 20.199 | 20.110 | 20.075 | 20.062 | 20.027 | 20.069 | 20.030 |

Average : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

-000-

1106484

RYG_EN0002

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykang, Huaykang, Bangkok 10310
Tel: +66 2943 8281-9, e-mail: service.thailand@sartorius.com



Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius
Certificate No. : 23BC0112
Issued Date : Friday, March 03, 2023
Reference No. : 204833
Page No. : 1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand

Calibrated By : Mr. Chonchai Inthana
Calibration Date : Wednesday, March 01, 2023
Calibration Procedure No. : This calibration was conducted by using in-house calibration procedure number (WH-003) Based on UKAS LAB 14 : 2019

Metrological data :
Capacity : 220 g Readability : 0.0001 g
Reasons for calibration :
☐ New Installation ☐ Service / Required ☒ Recalibration / Maintenance
Ambients Conditions :
Temperature : 23.6 °C ± 5.0 °C
Humidity : 60.0 % RH ± 10.0 % RH
Pressure :
Equipment Condition : ☒ Good Operation ☐ Fail

Measurement Method : UKAS Publication Ref : Lab 14
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

| Model Number | Description | Traceability | Certificate No | Due Date |
|---------------|---|--------------|----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2.YCS011-522-00 | SPC-RT | C02212565 | 14-Sep-2023 |
| MHB-382SD | Humidity/Barenometer/Temp. Luton MHB-382SD | DKSH | C19220444 | 5-Sep-2023 |

This certificate relate and apply the equipment only.
This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division
Sartorius (Thailand) Co., Ltd.

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykang, Huaykang, Bangkok 10310
Tel: +66 2943 8281-9 Fax: +66 2943 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius
Certificate No. : 23BC0112
Issued Date : Friday, March 03, 2023
Reference No. : 204833
Page No. : 2 of 2

Calibration Results : Without Adjustment

| Repeatability | | | Eccentricity (Off-center loading error) | | |
|---|---------|----------|---|---------|---|
| The repeatability is the ability of a weighing instrument to display nearly identical readings under constant load conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability qualitatively. | | | The off-center loading error is yielded by the difference between the reading of the load + 10 g or 100 g of maximum capacity placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R111). | | |
| Nominal Value (Low Load) | 20.0000 | 199.9999 | Nominal value | 100 | g |
| 20 g | 20.0000 | 200.0000 | Tolerance | 0.0004 | g |
| Tolerance | 0.0001 | g | Difference | | |
| | 20.0000 | 199.9999 | 1 | -0.0001 | |
| | 20.0000 | 200.0000 | 2 | -0.0001 | |
| | 20.0000 | 199.9999 | 3 | -0.0001 | |
| | 20.0000 | 200.0000 | 4 | 0.0001 | |
| | 20.0000 | 199.9999 | 5 | 0.0002 | |
| | 20.0000 | 200.0000 | 6 | - | |
| Standard Deviation | 0.00003 | 0.00005 | | | |

Linearity

The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the ideal: slope

| Tolerance | 0.0002 | g | | |
|---------------|-------------------------|-----------------|-----------|-------------|
| Nominal Value | Conventional Mass Value | Displayed Value | Deviation | Uncertainty |
| (g) | (g) | (g) | (g) | (g) |
| 0.01 | 0.0100 | 0.0100 | 0.0000 | 0.00014 |
| 0.05 | 0.0500 | 0.0500 | 0.0000 | 0.00014 |
| 0.1 | 0.1000 | 0.1000 | 0.0000 | 0.00014 |
| 0.5 | 0.5000 | 0.5000 | 0.0000 | 0.00014 |
| 1 | 1.0000 | 1.0000 | 0.0000 | 0.00014 |
| 5 | 5.0000 | 5.0000 | 0.0000 | 0.00014 |
| 10 | 10.0000 | 10.0001 | 0.0001 | 0.00014 |
| 20 | 20.0000 | 20.0000 | 0.0000 | 0.00024 |
| 50 | 50.0000 | 50.0000 | 0.0000 | 0.00015 |
| 100 | 100.0000 | 99.9999 | -0.0001 | 0.00019 |
| 200 | 200.0000 | 200.0000 | 0.0000 | 0.00032 |

End of Report

SOP FM 33 03 February 2022

RYG_EN0010



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
54/1 PATTANAKARN ROAD (H.M. V.I. AND A.V.I.) VANG BANGKOK 10260
TEL: 0 2219 9000 FAX: 0 2219 9001



Cert. No.: 22TM1517
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UFE 500
Serial No. : G511 1572
ID No. : RYG_EN0010

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location : Oven Room

Received Order : 20 October 2022
Calibration Date : 20 October 2022
Ambient Temperature : (26 ± 1) °C
Relative Humidity : (50 ± 3) %

Calibrated by : Man Pallaanapongsaiboon

Approved by :
Approved Signatory

() Ponthippa Tameyakul
() Malee Bulkruss
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate and report represent the data in full as given by the user.
Approved by: Man Pallaanapongsaiboon, Manager of Technology Promotion Association (Thailand-Japan)

A 0046908



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0375QC-2
Procedure Used :-

Cert. No.: 22TM1517
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---------------------|--------|------------|-----------|-------------|
| 1) Data Acquisition | 34972A | MY49029632 | 22LM97 | 29 Jul 2023 |

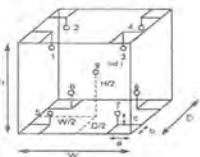
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.55 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

| Environment during calibration | | |
|--------------------------------|-----------|----------|
| | Beginning | Finished |
| Temp. (°C) | 25 | 25 |
| REL.Humid. (%) | 54 | 59 |
| AC Supply (Volt) | 223 | 225 |

| Ref. Std. ID No.: @ Calibration Point | | |
|---------------------------------------|------------|-------------|
| Position : | (180) °C | (104) °C |
| 1 | 21-16TC-01 | 20-16RTD-01 |
| 2 | 21-16TC-02 | 20-16RTD-02 |
| 3 | 21-16TC-03 | 20-16RTD-03 |
| 4 | 21-16TC-04 | 20-16RTD-04 |
| 5 | 21-16TC-05 | 22-16RTD-05 |
| 6 | 21-16TC-06 | 20-16RTD-06 |
| 7 | 21-16TC-07 | 20-16RTD-07 |
| 8 | 21-16TC-08 | 22-16RTD-08 |
| 9 (ref.) | 21-16TC-09 | 22-16RTD-09 |

Mulu

a 1132465



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376QC-2
Procedure Used :-

Cert. No.: 22TM1517
Page : 3 of 3

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

| Calibration Point (°C) | UUC* Setting (°C) | UUC* Reading (°C) | Temperature stability (± °C) | Temperature uniformity (°C) | Overall Variation (°C) | Uncertainty (± °C) | Coverage Factor k |
|------------------------|-------------------|-------------------|------------------------------|-----------------------------|------------------------|--------------------|-------------------|
| 104.0 | 104.0 | 104.0 | 0.076 | 0.52 | 0.60 | 0.42 | 2 |
| 180.0 | 180.0 | 180.0 | 0.13 | 0.86 | 1.2 | 1.1 | 2 |

| Measured Temperature (°C) | | | | | | | | | |
|---------------------------|----------|---------|---------|---------|---------|---------|---------|---------|----------|
| Point (°C) | Position | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 104.0 | 103.788 | 103.734 | 103.723 | 103.800 | 104.215 | 104.131 | 104.132 | 103.740 | 103.747 |
| 180.0 | 179.723 | 179.359 | 179.439 | 179.489 | 180.361 | 180.114 | 180.131 | 180.243 | 179.605 |

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

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

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation UUC* : Unit Under Calibration

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

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

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RYG_EN0006



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND) JAPAN
COORDINATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
10-1 PATTAYAKARN RD. BANGKOK 10110, THAILAND
TEL: 02-275-5991, 02-275-5992, 02-275-5993



Cert. No.: 22TM1492
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Manimart

Model : UM 400

Serial No. : b495 0899

ID No. : RYG_EN0006

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Pivakdaeng,
Rayong 21140, Thailand

Location : Oven Room

Received Order : 20 October 2022

Calibration Date : 20 October 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Praechai Hlanip

Approved by :
Approved Signatory

() Ponnitipha Tameyakul
() Malee Butkrupa
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND) JAPAN
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TEL: 02-275-5991, 02-275-5992, 02-275-5993

a 0046905



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376QC-1
Procedure Used :-

Cert. No.: 22TM1492
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---------------------|--------|------------|-----------|-------------|
| 1) Data Acquisition | 34970A | MY44035217 | 21LM30 | 23 Dec 2022 |

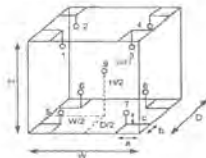
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



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

| Environment during calibration | | |
|--------------------------------|-----------|----------|
| | Beginning | Finished |
| Temp. (°C) | 28 | 29 |
| REL.Humid. (%) | 43 | 47 |
| AC Supply (Volt) | 220 | 221 |

| Position : | Ref. Std. ID No.: |
|------------|-------------------|
| 1 | 18-10RTD-01 |
| 2 | 18-10RTD-02 |
| 3 | 18-10RTD-03 |
| 4 | 18-10RTD-04 |
| 5 | 18-10RTD-05 |
| 6 | 18-10RTD-06 |
| 7 | 18-10RTD-07 |
| 8 | 18-10RTD-08 |
| 9 (ref.) | 18-10RTD-09 |

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Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2210-03780C-1
Result of Calibration :- (°) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No.: 22TM1492
 Page : 3 of 3

| Calibration Point (°C) | UUC* Setting (°C) | UUC* Reading (°C) | Temperature stability (± °C) | Temperature uniformity (°C) | Overall Variation (°C) | Uncertainty (± °C) | Coverage Factor K |
|--------------------------|---------------------|---------------------|--------------------------------|-------------------------------|--------------------------|----------------------|-------------------|
| 70.0 | 70.0 | 70.0 | 0.079 | 0.47 | 0.77 | 0.42 | 2 |

| Calibration Point (°C) | Measured Temperature (°C) | | | | | | | | |
|--------------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|----------|
| | Position | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 70.0 | 70.262 | 69.995 | 70.079 | 70.177 | 70.664 | 70.039 | 70.686 | 70.149 | 70.328 |

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

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
 Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
 Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration
 Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
 CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICE
 4142 PATTANAKARN ROAD SOI 19, SUKOLANG, SUKOLANG, BANGKOK 10110
 TEL. 0-2717-3000, 27 FAX 0-2719-8884



Cert. No.: 22TM1491
 Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath

Manufacturer : Memmert

Model : WNB22

Serial No. : L513.0648

ID No. : RYG_EN0061

Submitted by : A.S. Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
 616/10 Moo 5, T. Maenam Khu,
 A. Pluekdaeng,
 Rayong 21140, Thailand

Location : Wet Chemistry Lab

Received Order : 20 October 2022

Calibration Date : 20 October 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hahib

Approved by :
 Approved Signatory

() Ponthippa Taneyakul
 () Maiee Butkrues
 () Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95 %

This certificate is valid only for the item calibrated on date and place of calibration.
 Approval of the Head of Corporate Services & Equipment Calibration and Testing Service

0046906



Equipment : Water Bath
 Condition As-Received : Used Item
 Reference : 2210-03760C-4

Cert. No.: 22TM1491
 Page : 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|----------------------|--------|------------|-----------|-------------|
| 1) Data Acquisition | 34970A | MY44035217 | 21LM30 | 23 Dec 2022 |

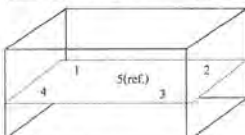
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (°) Without Adjustment

Function of UUC* : Temperature Source

| | Environmental (°C) (%R.H.) | | AC Voltage Supply (Volt) |
|--------------------------|--------------------------------|----|----------------------------|
| Beginning of Calibration | 24 | 53 | 222 |
| Finished of Calibration | 24 | 50 | 221 |



Front

| Position : | Ref. Std. S.N.: |
|------------|-----------------|
| 1 | N37P300726 |
| 2 | N37P300727 |
| 3 | N37P300728 |
| 4 | N37P300729 |
| 5 (ref.) | N37P300730 |

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Equipment : Water Bath
 Condition As-Received : Used Item
 Reference : 2210-03760C-4
Result of Calibration :- (°) Without Adjustment
 Function of UUC* : Temperature Source

Cert. No.: 22TM1491
 Page : 3 of 3

| Calibration point (°C) | UUC* Setting (°C) | UUC* Reading (°C) | Average* Standard Reading (°C) | | | | |
|--------------------------|---------------------|---------------------|----------------------------------|--------|--------|--------|----------|
| | | | Position | | | | |
| | | | 1 | 2 | 3 | 4 | 5 (ref.) |
| 85.0 | 85.0 | 85.0 | 84.527 | 84.563 | 84.628 | 84.516 | 84.580 |

| Calibration point (°C) | Uniformity (°C) | Stability (± °C) | Uncertainty (± °C) | Coverage Factor K |
|--------------------------|-------------------|--------------------|----------------------|-------------------|
| 85.0 | 0.12 | 0.081 | 0.18 | 2 |

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

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

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

UUC* : Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 11, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3009-24 FAX. 0-2716-6484



Certificate of Calibration

Certificate No.: 22T1593
Page: 1 of 2

Equipment: Digital Thermometer With Sensor
Manufacturer: Testo
Model: 106
Serial No.: 51366093/1220
ID No.: RYG_FS0542

This certificate may not be reproduced other than in full
except with the prior written approval of the head of
Corporate Services 3: Equipment Calibration and Testing Services

Condition As-Received: Used Item
Received Date: 26 August 2022
Calibration Date: 31 August 2022
Reference: 2205-0964DSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
616/10 Moo 5 T. Maenam Kh. A. Phakdaeng, Rayong
21140, Thailand

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with
Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

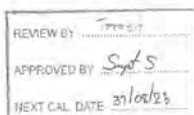
1. Reference standards instruments

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|---|-------|------------|-----------------|-------------|
| 1) Digital Thermometer | 1329 | A7A002 | 211126 | 14 Oct 2022 |
| 2) Industrial Platinum Resistance Thermometer | 5627 | 824304 | 211126 | 14 Oct 2022 |

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

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

- National Institute of Metrology Thailand (NIMT)



Calibrated by: Nam Srimgai
Issue Date: 12 September 2022

Approved Signatory:
1. Phasinee Prathapet
2. Chatchawan Khunpilai
3. Wanlop Larkpim

B 0296667



Cert. No.: 22T1593
Page: 2 of 2

Result of Calibration: Without Adjustment
Function: Temperature measurement
Dimension of probe: Diameter 3 mm., Length 55 mm. Sheath material: Stainless Steel

| Immersion Depth (mm.) | Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty of Measurement (± °C) |
|-----------------------|---------------------------|-------------------|------------|-----------------------------------|
| 50 | 24.9987 | 25.0 | 0.0013 | 0.12 |
| 50 | 30.0032 | 30.0 | -0.0032 | 0.12 |
| 50 | 39.9959 | 40.1 | 0.1041 | 0.12 |

UUC* : Unit Under Calibration

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

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TEL. 0-2717-3009-24 FAX. 0-2716-6484



Cert. No.: 22CH988
Page: 1 of 3

Certificate of Calibration

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: Seven2GoS2
Serial No.: B712868291
ID No.: RYG_FS0298

Condition As-Received: Used Item
Received Date: 21 July 2022
Calibration Date: 22 July 2022

Reference: 2207-08100SC-1

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Kh. A. Phakdaeng,
Rayong 21140, Thailand

Ambient Temperature: (25 ± 2.5) °C
Relative Humidity: (50 ± 15) %

Calibration Procedure:
In-house method
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH6 by comparison with standard thermometer

Calibrated by: Warakorn Lemgatrakul

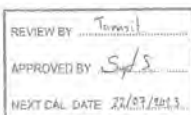
Approved by: Warakorn Lemgatrakul
Approved Signatory

1. Malee Butkrues
2. Sathip Meangmai
3. Warakorn Lemgatrakul

Issue Date: 21 July 2022

The Uncertainties are for a confidence probability of approximately 95%

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



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Cert. No.: 22CH988
Page: 2 of 3

Condition of this calibration result

- Reference Standard Instrument

| Instrument | Serial No. | ID No. | Cert. No. | Due Date |
|--------------------------------|------------|----------|-----------|-------------|
| 1) Document Process Calibrator | 54030049 | 130RC116 | 21E2682 | 25 Aug 2022 |
| 2) Ref. Standard Thermometer | 4982054 | 110RC044 | 2111201 | 26 Oct 2022 |

This certification is traceable to the International System of Unit maintained at:
- Traceable to National Institute of Metrology (Thailand), NIMT
- Certified Reference Materials
The measurement results are traceable to SI through CPA chem (Ltd.)
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| Buffer Solution | Manufacturer | Lot No. | Exp. date |
|-----------------|--------------|---------|--------------|
| pH 4.008 | CPA chem | 823320 | 20 June 2024 |
| pH 6.985 | CPA chem | 794122 | 14 Feb 2023 |
| pH 10.008 | CPA chem | 823323 | 20 June 2023 |

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

Calibration Results

Function: mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

| Unit Under Calibration | Nominal Value | Standard Voltage Input | Actual Reading | | Uncertainty of Measurement (± mV) | Coverage factor |
|-----------------------------|---------------|------------------------|----------------|-------|-----------------------------------|-----------------|
| | | | mV | pH | | |
| pH Meter S/N: B712869291 | 4.00 | 177.48 | 178 | 4.00 | 0.58 | 2.00 |
| | 7.00 | 0.00 | 0 | 7.00 | 0.58 | 2.00 |
| | 10.00 | -177.48 | -178 | 10.00 | 0.58 | 2.00 |

Warakorn

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Cert.No.: 22CH988
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

| Unit Under Calibration | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH measurement (\pm) | Coverage factor k |
|-------------------------------|-----------------------------|-----------------------|------------------------|---|----------------------|
| pH Electrode S/N.: 9055658 | 4.006 6.985 10.006 | 4.01 6.99 10.01 | 176 2 -165 | 0.0085 0.0099 0.011 | 2.05 2.00 2.07 |

Function : Temperature Measurement

($^{\circ}$) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLab Expert Go-ISM

- Serial No. : 9055659

Dimension of probe:

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

| Calibration Point ($^{\circ}$ C) | Standard Temperature ($^{\circ}$ C) | UUC* Reading ($^{\circ}$ C) | Error ($^{\circ}$ C) | Uncertainty of measurement (\pm $^{\circ}$ C) | Coverage factor k |
|-----------------------------------|--------------------------------------|------------------------------|-----------------------|--|-------------------|
| 25.0 | 25.003 | 24.8 | -0.203 | 0.13 | 2.00 |

Remark : - UUC* = Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD MU 10 SUANLUANG, SUANLUNG BANGKOK 10250
TEL. 0-2177-8000-27 FAX. 0-2178-0888



Cert.No.: 22CH1084
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : C129171492
ID No. : RYG_FS0549
Condition As-Received : Used Item
Received Date : 17 August 2022
Calibration Date : 18 August 2022
Reference : 2208-0623DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Ambient Temperature : (25 \pm 2.5) $^{\circ}$ C
Relative Humidity : (50 \pm 15) %
Calibration Procedure : In-house method
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
Calibrated by : Warakorn Lerngagrakul
Approved by :
Approved Signatory
(☒) Malee Butkruea
(☐) Sathip Meangmai
(☐) Warakorn Lerngagrakul
Issue Date : 22 August 2022

The Uncertainties are for a confidence probability of approximately 95 %

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Approval of the head of Laboratory Services : (Equipment Calibration and Testing Service)

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Cert. No.: 22CH1084
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

| Instrument | Serial No. | ID No. | Cert. No. | Due Date |
|--------------------------------|------------|----------|-----------|-------------|
| 1) Document Process Calibrator | 54030048 | 130RC116 | 21E2682 | 25 Aug 2022 |

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

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

| Buffer Solution | Manufacturer | Lot No. | Exp. date |
|-----------------|--------------|---------|--------------|
| pH 4.006 | CPA chem | 823320 | 20 June 2024 |
| pH 6.985 | CPA chem | 794122 | 14 Feb 2023 |
| pH 10.006 | CPA chem | 823323 | 20 June 2023 |

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

| Unit Under Calibration | Nominal Value | Standard Voltage Input | Actual Reading | Uncertainty of Measurement (\pm mV) | Coverage factor k |
|------------------------------|-----------------------|---------------------------|------------------|--|----------------------|
| | pH | mV | mV | pH | |
| pH Meter S/N.: C129171492 | 4.00 7.00 10.00 | 177.48 0.00 -177.48 | 178 0 -178 | 4.00 7.00 10.00 | 0.58 0.58 0.58 |

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

| Unit Under Calibration | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH measurement (\pm) | Coverage factor k |
|-------------------------------|-----------------------------|-----------------------|------------------------|---|----------------------|
| pH Electrode S/N.: 1231783 | 4.006 6.985 10.006 | 4.01 7.00 10.00 | 171 -2 -174 | 0.0086 0.011 0.0092 | 2.05 2.00 2.00 |

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2177-8000-27 FAX. 0-2178-0888



Cert. No.: 22LM112
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : C129171492
ID No. : RYG_FS0549
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 17 August 2022
Calibrated Date : 19 August 2022
Ambient Temperature : (26 \pm 10) $^{\circ}$ C
Relative Humidity : (50 \pm 30) %
AC Line Voltage : (220 \pm 22) V
Calibrated by : Kunchit Promprat
Approved by :
Approved Signatory
(☐) Ponnitipha Tameyakul
(☐) Malee Butkruea
(☒) Suwit Imjai
Issue Date : 24 August 2022

The Uncertainties are for a confidence probability of approximately 95 %

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Approval of the head of Laboratory Services : (Equipment Calibration and Testing Service)

A 0044522



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2208-06230SC-3

Cert. No.: 22LM112
Page: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-0701 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument Model Serial No. Cert. No. Due Date
1) Digital Thermometer 1502A A52647 211144 20 Oct 2022

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1231783

| Calibration Point (°C) | Immersion Depth (mm) | Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty (± °C) | Coverage Factor k |
|------------------------|----------------------|---------------------------|-------------------|------------|--------------------|-------------------|
| 25.0 | 120 | 24.999 | 25.1 | 0.101 | 0.16 | 2.00 |
| 30.0 | 120 | 30.001 | 30.1 | 0.099 | 0.16 | 2.00 |
| 40.0 | 120 | 40.004 | 40.1 | 0.096 | 0.16 | 2.00 |
| 50.0 | 120 | 50.003 | 50.1 | 0.097 | 0.16 | 2.00 |

UUC* : Unit Under Calibration

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

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R48 FS 0604

METTLER TOLEDO

Certificate Number CPH-0203-22

Calibration Certificate Seven2Go™ pH/mV meter S2

Customer

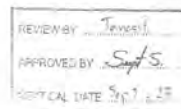
Company: A.S. LABORATORY GROUP (THAILAND) CO., LTD.
Address: 816/10 Km. 2 T. Maemurak, A. Phum Saeng
RAYONG 21140
Customer ID number: 01988073
Customer representative:

Instrument

Type: Seven2Go™ green S2 Instrument Serial Number: C22030001
Internal identification: (Traceable version: 1.31)

Technical specifications

Measuring Range: 1999.9 - 1999.9 mV (pH: 70 pH)
Resolution: 1 mV 0.01 pH
Limit of Error: ± 1 mV ± 0.01 pH
Temperature range NTC: ± 105 °C
Temperature range ATC: ± 105 °C
Resolution: 0.1 °C
Limit of Error: ± 0.3 °C



Procedure Statement

METTLER TOLEDO Seven2Go™ Service Manual Section 8 (p. 16, No. 3023219) will be used as referring documentation to adjust and verify the instrument included in the "Type" and "Serial number" section. The measurement results of this calibration were obtained at ambient conditions.

METTLER TOLEDO

Certificate Number CPH-0203-22

Certification Tools

Certified Digital voltmeter Manufacturer: METTLER PACEMAN 34401A
Type: 34401A
Serial number: 062022111
Certificate number: 21072001
Date of Calibration: September 1, 2022

Certified Temperature Reference Manufacturer: METTLER TOLEDO
Type: 11802416
Serial number: A221
Certificate number: 03871
Date of Calibration: April 27, 2022

| Description | Nominal value | Certified value |
|------------------|---------------|-----------------|
| NTC 30 kΩ 0 °C | 34.886 kΩ | 34.911 kΩ |
| NTC 30 kΩ 25 °C | 20.932 kΩ | 20.957 kΩ |
| NTC 30 kΩ 50 °C | 13.988 kΩ | 13.963 kΩ |
| NTC 30 kΩ 75 °C | 8.578 kΩ | 8.529 kΩ |
| NTC 30 kΩ 100 °C | 5.012 kΩ | 5.066 kΩ |

METTLER TOLEDO

Certificate Number CPH-0203-22

Certification Measurements

| Designation | Certified value | Measured value | Max. Tolerance | Passed / Failed |
|-------------|-----------------|----------------|----------------|-----------------|
| 1999.9 mV | 1999.9 mV | 1999.9 mV | 1 mV | Passed |
| -1999.9 mV | -1999.9 mV | -1999.9 mV | 1 mV | Passed |
| 999.9 mV | 999.9 mV | 999.9 mV | 1 mV | Passed |
| -999.9 mV | -999.9 mV | -999.9 mV | 1 mV | Passed |
| 0 mV | 0 mV | 0 mV | 1 mV | Passed |
| 180 mV | 180 mV | 180 mV | 1 mV | Passed |
| 500 mV | 500 mV | 500 mV | 1 mV | Passed |
| 1000 mV | 1000 mV | 1000 mV | 1 mV | Passed |
| 1900 mV | 1900 mV | 1900 mV | 1 mV | Passed |

| Designation | Nominal value | Measured value | Max. Tolerance | Passed / Failed |
|------------------|---------------|----------------|----------------|-----------------|
| NTC 30 kΩ 0 °C | 34.9 °C | 34.9 °C | 0.5 °C | Passed |
| NTC 30 kΩ 25 °C | 25.0 °C | 25.1 °C | 0.5 °C | Passed |
| NTC 30 kΩ 50 °C | 50.0 °C | 50.1 °C | 0.5 °C | Passed |
| NTC 30 kΩ 75 °C | 75.0 °C | 75.1 °C | 0.5 °C | Passed |
| NTC 30 kΩ 100 °C | 100.0 °C | 100.0 °C | 0.5 °C | Passed |

Summary of Certification

Certification of instrument

Passed

The statement referred to in this certificate has fulfilled the purpose of the calibration. This is indicated by the column Passed in the column above.

Remarks: Serial Assessment ID: 0197019803

Test-high impedance at 1000 Ω min. (Resist: 1500 Ω)

Stability: ± 0.2 % (Water MPE @ 1 %)

Certification of this instrument was performed by

Name: Wuttan Thongthong Function: Service Technician
Company: METTLER TOLEDO

Date: September 26, 2022 Signature: Wuttan T.

Performance Test

Attachment to Certificate No. CPH-0205-22

pH Electrode

Type InLab Expert Go-ISM SNV 2295895

Certified standards used

| | | | | | | |
|-------------|----------------|----------------|--------------|----------------|-----------|--------|
| Standard 1: | Type | pH Buffer | Manufacturer | METTLER TOLEDO | Exp. date | Jun-24 |
| | Nominal value: | pH (25.00 °C): | 4.01 | Lot No. | 1H15AG | |
| Standard 2: | Type | pH Buffer | Manufacturer | METTLER TOLEDO | Exp. date | Jan-24 |
| | Nominal value: | pH (25.00 °C): | 7.00 | Lot No. | 1H013D | |
| Standard 3: | Type | pH Buffer | Manufacturer | METTLER TOLEDO | Exp. date | May-24 |
| | Nominal value: | pH (25.00 °C): | 9.20 | Lot No. | 1H13DA | |
| Standard 4: | Type | Redox Solution | Manufacturer | METTLER TOLEDO | Exp. date | — |
| | Nominal value: | pH (25.00 °C): | — | Lot No. | — | |

Adjustment

| | | | | | | | |
|-------------------------|--|--|------|---------------------|-----|---------------------|----|
| Set Calibration Buffer | | 82 (25 °C) 2.00, 4.01, 7.00, 9.21, 11.00 | | | | | |
| Select Calibration Mode | | 3-Point calibration | | 2-Point calibration | | 2-Point calibration | |
| 3-Point Calibration | | °C | pH | °C | pH | °C | pH |
| Cal 1 | | ATC | 25.9 | 4.01 | ATC | 25.0 | - |
| Cal 2 | | ATC | 25.9 | 7.00 | ATC | 25.0 | - |
| Offset (mV) | | 19 | | | | | |
| Slope % (or mV/pH) | | 96.4 | | | | | |
| Cal 3 | | ATC | 26.0 | 9.20 | | | |
| Slope % (or mV/pH) | | 100 | | | | | |

Measurements

| Before adjustment | | | | After adjustment | | | | | |
|-------------------|------|----------|------------|------------------|------|----------|------------|------|-------|
| Buffer Values | | Measured | Difference | Buffer Values | | Measured | Difference | | |
| pH | °C | pH | pH | pH | °C | pH | pH | | |
| 4.01 | 25.9 | ATC | -3.99 | -0.02 | 4.01 | 26.1 | ATC | 4.00 | -0.01 |
| 7.00 | 26.0 | ATC | 6.96 | -0.04 | 7.00 | 26.0 | ATC | 7.01 | 0.01 |
| 9.19 | 25.9 | ATC | 9.16 | -0.03 | 9.16 | 26.1 | ATC | 9.19 | 0.00 |

Redox Measurement Result: — mV

Note: The difference result of calibrated electrode should be within ± 0.05 pH.

Remarks

Place: Chemical Laboratory Calibration Date: September 26, 2022

Service Specialist: Watinee Thongrod Signature: *Watinee T.*

R46-FSC605

METTLER TOLEDO

Certificate Number CPH-0205-22

Calibration Certificate
Seven2Go™ pH/mV meter S2

Customer

Company: ALS LABORATORY GROUP (THAILAND) CO., LTD.
Address: 610/10 Moo 5, T. Maemurak, A. Road (Bang)
RAYONG 21169
Customer ID number: 01686073
Customer representative: —

Instrument

Type: Seven2Go™ pH/mV S1 Instrument Serial Number: C232156424
Internal Identification: — Firmware version: 1.01

Technical specifications

Measuring Range: -1999.9 ~ 1999.9 mV ± 30 pH
Resolution: 1 mV 0.01 pH
Limit of Error: ± 1 mV ± 0.01 pH
Temperature range 0°C ~ 100 °C
Temperature range ATC: ± 100 °C
Resolution: 0.1 °C
Limit of Error: ± 0.5 °C

REVIEW BY: *T. Thongrod*
APPROVED BY: *S. S.*
NEXT CAL DATE: Sep 26, 25

Procedure Statement

METTLER TOLEDO Seven2Go Series Manual Section 8 (Elev. No. 20220216) will be used as reference documentation to adjust and verify the instrument indicated in the "Type" and "Serial number" section. The measurement results of this certification were obtained as precise as possible.

METTLER TOLEDO

Certificate Number CPH-0205-22

Certification Tools

Certified digital voltmeter: Manufacturer: HANNA (TT-PACKARD) / 34431A
Type: —
Serial number: UC2053111
Certificate number: 1-12222943
Date of Certification: September 2, 2022

Certified Temperature Resistor: Manufacturer: METTLER TOLEDO
Type: 31503410
Serial number: 4221
Certificate number: 3-1811
Date of Certification: April 23, 2022

| Designation | Nominal value | Certified value |
|-------------------|---------------|-----------------|
| NTC 30 kΩ, 0 °C | 84 980 kΩ | 84 981 kΩ |
| NTC 30 kΩ, 25 °C | 20 000 kΩ | 20 022 kΩ |
| NTC 30 kΩ, 50 °C | 10 900 kΩ | 10 903 kΩ |
| NTC 30 kΩ, 75 °C | 4 528 kΩ | 4 528 kΩ |
| NTC 30 kΩ, 100 °C | 2 050 kΩ | 2 060 kΩ |

METTLER TOLEDO

Certificate Number CPH-0205-22

Certification Measurements

| Designation | Certified value | Measured value | Max. Tolerance | Passed / Failed |
|-------------|-----------------|----------------|----------------|-----------------|
| 0 mV | 0.000 mV | 0.000 mV | ± 1 mV | Passed |
| 1000 mV | 1000.0 mV | 1000.0 mV | ± 1 mV | Passed |
| 1500 mV | 1500.0 mV | 1500.0 mV | ± 1 mV | Passed |
| 1800 mV | 1800.0 mV | 1800.0 mV | ± 1 mV | Passed |
| 0 mV | 0.0 mV | 0.0 mV | ± 1 mV | Passed |
| 180 mV | 180.0 mV | 180.0 mV | ± 1 mV | Passed |
| 500 mV | 500.0 mV | 500.0 mV | ± 1 mV | Passed |
| 1000 mV | 1000.0 mV | 1000.0 mV | ± 1 mV | Passed |
| 1600 mV | 1600.0 mV | 1600.0 mV | ± 1 mV | Passed |

| Designation | Nominal value | Measured value | Max. Tolerance | Passed / Failed |
|-------------------|---------------|----------------|----------------|-----------------|
| NTC 30 kΩ, 0 °C | 0 °C | 0.5 °C | ± 0.5 °C | Passed |
| NTC 30 kΩ, 25 °C | 25.0 °C | 25.1 °C | ± 0.5 °C | Passed |
| NTC 30 kΩ, 50 °C | 50.0 °C | 50.2 °C | ± 0.5 °C | Passed |
| NTC 30 kΩ, 75 °C | 75.0 °C | 75.1 °C | ± 0.5 °C | Passed |
| NTC 30 kΩ, 100 °C | 100.0 °C | 100.0 °C | ± 0.5 °C | Passed |

Summary of Certification

Certification of instrument **Passed**

The instrument returned to us in this certificate has fulfilled the criteria of this certification. This is indicated by the notation "Passed" in the column above.

Remarks: Service Assignment ID: 031015803
Test high impedance at 1000.0 mV, Result: 1900 mV
Difference: $\pm 0.5\%$ Within MPE of $\pm 1\%$
Certification of the instrument was performed by
Name: Watinee Thongrod Function: Service Technician
Company: METTLER TOLEDO
Date: September 26, 2022 Signature: *Watinee T.*

Performance Test

Attachment to Certificate No. CPH-005-02

pH Electrode

Type: InLab Expert Go-ISM S/N: 2394440

Certified standards used

| | | | | | | |
|-------------|----------------|-----------------|--------------|----------------|-----------|--------|
| Standard 1: | Type | pH Buffer | Manufacturer | METTLER TOLEDO | Exp. date | Jun-24 |
| | Nominal value: | pH (25.00 °C): | 4.01 | | Lot No. | 711520 |
| Standard 2: | Type | pH Buffer | Manufacturer | METTLER TOLEDO | Exp. date | Jan-24 |
| | Nominal value: | pH (25.00 °C): | 7.00 | | Lot No. | 710130 |
| Standard 3: | Type | pH Buffer | Manufacturer | METTLER TOLEDO | Exp. date | May-24 |
| | Nominal value: | pH (25.00 °C): | 9.20 | | Lot No. | 711294 |
| Standard 4: | Type | Redox Solution | Manufacturer | METTLER TOLEDO | Exp. date | - |
| | Nominal value: | pH (25.00 °C): | - | | Lot No. | - |

Adjustment

| | | | | | | | |
|-------------------------|--|--------------------------------------|------|---------------------|-----|---------------------|----|
| Set Calibration Buffer | | 47 (25 °C) 2.00 4.01 7.00 9.21 11.00 | | | | | |
| Select Calibration Mode | | 3-Point calibration | | 2-Point calibration | | 1-Point calibration | |
| 3-Point Calibration | | °C | pH | °C | pH | °C | pH |
| Cal 1 | | ATC | 25.3 | 4.01 | ATC | 25.0 | - |
| Cal 2 | | ATC | 25.0 | 7.00 | ATC | 25.0 | - |
| Offset (mV) | | 19 | | - | | - | |
| Slope % (or mV/pH) | | 97.7 | | - | | - | |
| Cal 3 | | ATC | 25.3 | 9.21 | - | | |
| Slope % (or mV/pH) | | 99.0 | | - | | | |

Measurements

| Before adjustment | | | | After adjustment | | | |
|-------------------|----------|------------|------|------------------|----------|------------|------|
| Buffer Values | Measured | Difference | | Buffer Values | Measured | Difference | |
| pH | °C | pH | pH | pH | °C | pH | pH |
| 4.01 | 25.4 | ATC | 3.98 | 4.01 | 25.3 | ATC | 4.02 |
| 7.00 | 25.1 | ATC | 6.96 | 7.00 | 25.1 | ATC | 7.01 |
| 9.20 | 25.2 | ATC | 9.13 | 9.20 | 25.3 | ATC | 9.21 |

Before Measurement Result: mV

Note: The difference result of calibrated electrode should be within ± 0.05 pH.

Remarks:

Place: Chemical Laboratory Calibration Date: September 28, 2022

Service: Sanyasiri Wattanee Thongrod Signature: Wattanee T.

ภาคผนวก จ

สำเนาหนังสืออนุญาตขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|---------------------|---|
| 19 | Copper | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 20 | Cyanide | Distillation, Colorimetric Method ⁽⁴⁾ |
| 21 | 2,4'-DDD | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 22 | 4,4'-DDD | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 23 | 2,4'-DDE | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 24 | 4,4'-DDE | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 25 | 2,4'-DDT | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 26 | 4,4'-DDT | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 27 | Dieldrin | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 28 | Endosulfan Sulfate | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 29 | Endosulfan I | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 30 | Endosulfan II | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 31 | Endrin | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 32 | Endrin Aldehyde | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 33 | Formaldehyde | Distillation, Colorimetric Method ⁽⁴⁾ |
| 34 | Free Chlorine | 1) DPD Ferrous Titrimetric Method ⁽⁴⁾ 2) Iodometric Method ⁽⁴⁾ |
| 35 | Heptachlor | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 36 | Heptachlor epoxide | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 37 | Hexavalent Chromium | Filtration, Colorimetric Method ⁽⁴⁾ |
| 38 | 3-Hydroxycarbofuran | High-Performance Liquid Chromatographic Method ⁽⁴⁾ |
| 39 | Lead | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 40 | Manganese | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 41 | Mercury | 1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/Mass spectrometric Method ⁽⁴⁾ |
| 42 | Methiocarb | High-Performance Liquid Chromatographic Method ⁽⁴⁾ |
| 43 | Methoxychlor | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |

วิมล
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-----ศูนย์เคมีภัณฑ์

44 Methomyl...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|-------------------------|---|
| 44 | Methomyl | High-Performance Liquid Chromatographic Method ⁽⁴⁾ |
| 45 | Nickel | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 46 | Oil & Grease | 1) Liquid-Liquid, Partition-Gravimetric Method ⁽⁴⁾ 2) Soxhlet Extraction Method ⁽⁴⁾ |
| 47 | Oxamyl | High-Performance Liquid Chromatographic Method ⁽⁴⁾ |
| 48 | Propoxur | High-Performance Liquid Chromatographic Method ⁽⁴⁾ |
| 49 | pH | Electrometric Method ⁽⁴⁾ |
| 50 | Phenols | 1) Distillation, Chloroform Extraction Method ⁽⁴⁾ 2) Distillation, Direct Photometric Method ⁽⁴⁾ |
| 51 | Selenium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 52 | Sulfide | Iodometric Method ⁽⁴⁾ |
| 53 | Temperature | Laboratory and Field Methods ⁽⁴⁾ |
| 54 | Total Dissolved Solids | Dried at 180 °C ⁽⁴⁾ |
| 55 | Total Kjeldahl Nitrogen | Semi-Micro Kjeldahl Method ⁽⁴⁾ |
| 56 | Total Suspended Solids | Dried at 103-105 °C ⁽⁴⁾ |
| 57 | Toxaphene | Liquid-Liquid Extraction, Gas Chromatographic Method ⁽⁴⁾ |
| 58 | Trivalent Chromium | 1) Digestion, Inductively Coupled Plasma Method/ Colorimetric Method; Calculation ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation ⁽⁴⁾ |
| 59 | Zinc | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁽⁴⁾ |

น้ำดื่ม จำนวน 126 รายการ

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|--------------|--|
| 1 | Acenaphthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 2 | Acetone | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |

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3 Aldrin...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|-------------------------|---|
| 3 | Aldrin | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 4 | Anthracene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 5 | Antimony | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 6 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 7 | Atrazine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 8 | Barium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 9 | Benz(a)anthracene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 10 | Benzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 11 | Benzo(b)fluoranthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 12 | Benzo(k)fluoranthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 13 | Benzoic Acid | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 14 | Benzo(a)pyrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 15 | Benzo(g,h,i)perylene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 16 | Beryllium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 17 | Bis(2-chloroethyl)ether | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |

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18 Bis(2-ethylhexyl)phthalate...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|----------------------------|---|
| 18 | Bis(2-ethylhexyl)phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 19 | Bromodichloromethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 20 | Bromoform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 21 | Butanol | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 22 | Butyl Benzyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 23 | Caesium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 24 | Carbazole | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 25 | Carbon Disulfide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 26 | Carbon tetrachloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 27 | Chlordane | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 28 | p-Chloroaniline | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 29 | Chlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 30 | Chlorodibromomethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 31 | Chloroform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 32 | 2-Chlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 33 | Chromium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |

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-----ศูนย์เคมีภัณฑ์

34 Chromium (III)...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|-----------------------|--|
| 34 | Chromium (III) | 1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation ⁽⁴⁾ |
| 35 | Chromium (VI) | Colorimetric Method ⁽⁴⁾ |
| 36 | Chrysene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 37 | Cyanide | Distillation, Colorimetric Method ⁽⁴⁾ |
| 38 | 2,4-D | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 39 | DDD | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 40 | DDE | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 41 | DDT | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 42 | Dibenz(a,h)anthracene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 43 | Di-n-Butyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 44 | 1,2-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 45 | 1,3-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 46 | 1,4-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 47 | 3,3-Dichlorobenzidine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 48 | 1,1-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 49 | 1,2-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 50 | 1,1-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |

51 cis-1,2-Dichloroethylene...

(นางสาวกัญจน์ นัตรฤทธิไธ)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์และทดสอบ
กรมวิทยาศาสตร์บริการ

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|----------------------------|---|
| 51 | cis-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 52 | trans-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 53 | 2,4-Dichlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 54 | 1,2-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 55 | 1,3-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 56 | 1,3-Dichloropropene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 57 | Dieldrin | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 58 | Diethyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 59 | 2,4-Dimethylphenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 60 | 2,4-Dinitrophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 61 | 2,4-Dinitrotoluene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 62 | 2,6-Dinitrotoluene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 63 | Di-n-Octyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 64 | Endosulfan | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 65 | Endrin | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 66 | Ethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 67 | Fluoranthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |

68 Fluorene...

(นางสาวกัญจน์ นัตรฤทธิไธ)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์และทดสอบ
กรมวิทยาศาสตร์บริการ

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|---------------------------|---|
| 68 | Fluorene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 69 | Heptachlor | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 70 | Heptachlor epoxide | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 71 | Hexachlorobenzene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 72 | Hexachloro-1,3-butadiene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 73 | n-Hexane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 74 | α-HCH | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 75 | β-HCH | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 76 | γ-HCH | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 77 | Hexachlorocyclopentadiene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 78 | Hexachloroethane | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 79 | Indeno(1,2,3-cd)pyrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 80 | Isophorone | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 81 | Lead | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 82 | Manganese | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 83 | Mercury | 1) Cold Vapor Atomic Absorption Spectrometric Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |

84 Methanol...

(นางสาวกัญจน์ นัตรฤทธิไธ)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์และทดสอบ
กรมวิทยาศาสตร์บริการ

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|---|---|
| 84 | Methanol | 1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 85 | Methoxychlor | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 86 | Methyl Bromide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 87 | Methylene Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 88 | 2-Methylphenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 89 | 2-Methylnaphthalene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 90 | Methyl tert-Butyl Ether | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 91 | Naphthalene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 92 | Nickel | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 93 | Nitrobenzene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 94 | N-Nitrosodiphenylamine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 95 | N-Nitrosodi-n-Propylamine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 96 | Polychlorinated Biphenyls - PCB 1016 - PCB 1221 - PCB 1232 - PCB 1242 - PCB 1248 - PCB 1254 - PCB 1260 | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |

97 Pentachlorophenol...

(นางสาวกัญจน์ นัตรฤทธิไธ)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์และทดสอบ
กรมวิทยาศาสตร์บริการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---|--|
| 97 | Pentachlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 98 | pH | Electrometric Method ⁽⁴⁾ |
| 99 | Phenanthrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 100 | Phenol | 1) Distillation, Direct Photometric Method ⁽⁴⁾ 2) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 101 | Pyrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 102 | Selenium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 103 | Silver | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 104 | Styrene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 105 | 1,1,2,2-Tetrachloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 106 | Tetrachloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 107 | Toluene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 108 | Toxaphene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 109 | TPH (C ₇ -C ₉) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽¹⁾⁽²⁾⁽⁴⁾ |
| 110 | TPH (C ₁₀ -C ₁₄) | Solvent Extraction, Gas Chromatographic Method ⁽⁹⁾⁽²¹⁾ |
| 111 | TPH (C ₁₅ -C ₃₀) | Solvent Extraction, Gas Chromatographic Method ⁽⁹⁾⁽²¹⁾ |
| 112 | 1,2,4-Trichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 113 | 1,1,1-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |

114 1,1,2-Trichloroethane...

(นายวิภากร บุญ อัครสกุลวิไล)
ผู้อำนวยการศูนย์มาตรฐานวิชาการกองกลางจังหวัดขอนแก่น
และศูนย์มาตรฐานวิชาการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|------------------------|---|
| 114 | 1,1,2-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 115 | Trichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 116 | 2,4,6-Trichlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 117 | 2,4,6-Trichlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 118 | 1,3,5-Trimethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 119 | Vanadium | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |
| 120 | Vinyl Acetate | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 121 | Vinyl Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 122 | m-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 123 | c-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 124 | p-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 125 | Xylene (Total) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ⁽⁴⁾ |
| 126 | Zinc | 1) Digestion, Inductively Coupled Plasma Method ⁽⁴⁾ 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁴⁾ |

จากภาคพืช (พืชตระกูลถั่ว) จำนวน 16 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 1 | Antimony | Isokinetic, Digestion, Inductively Coupled Plasma Method ⁽³⁾ |
| 2 | Arsenic | Isokinetic, Digestion, Inductively Coupled Plasma Method ⁽³⁾ |

3 Carbon Monoxide...

(นายวิภากร บุญ อัครสกุลวิไล)
ผู้อำนวยการศูนย์มาตรฐานวิชาการกองกลางจังหวัดขอนแก่น
และศูนย์มาตรฐานวิชาการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-----------------------------|---|
| 3 | Carbon Monoxide | 1) Sampling Bag Non-Dispersive Infrared Method ⁽²⁾ 2) Non-Dispersive Infrared Method ⁽³⁾ 3) Instrumental Analyzer Method ⁽³⁾ |
| 4 | Chlorine | 1) Absorption Sampling, Ion Chromatographic Method ⁽³⁾ 2) Isokinetic Sampling, Ion Chromatographic Method ⁽¹⁾ |
| 5 | Copper | Isokinetic, Digestion, Inductively Coupled Plasma Method ⁽³⁾ |
| 6 | Dioxins | Isokinetic Sampling, Analysis by ISO/IEC 17025 Accredited Laboratory or Analysis by Department of Industrial Works Registered Laboratory (Dioxins/Furans Analysis Approved) ⁽³⁾ |
| 7 | Hydrogen Chloride | 1) Absorption Sampling, Ion Chromatographic Method ⁽³⁾ 2) Isokinetic Sampling, Ion Chromatographic Method ⁽¹⁾ |
| 8 | Hydrogen Sulfide | Absorption Sampling, Iodometric Method ⁽³⁾ |
| 9 | Lead | Isokinetic, Digestion, Inductively Coupled Plasma Method ⁽³⁾ |
| 10 | Mercury | 1) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁽³⁾ 2) Isokinetic, Digestion, Inductively Coupled Plasma Method ⁽³⁾ |
| 11 | Opacity | Ringelmann's Method ⁽³⁾ |
| 12 | Oxides of Nitrogen | 1) Absorption Sampling, Phenoldisulfonic Acid Method ⁽³⁾ 2) Chemiluminescence Method ⁽³⁾ 3) Instrumental Analyzer Method ⁽³⁾ |
| 13 | Sulfur Dioxide | 1) Absorption Sampling, Barium-Thoron Titrimetric Method ⁽³⁾ 2) UV Fluorescence Method ⁽³⁾ 3) Instrumental Analyzer Method ⁽³⁾ |
| 14 | Sulfuric Acid | Isokinetic Sampling, Barium-Thoron Titrimetric Method ⁽³⁾ |
| 15 | Total Suspended Particulate | Isokinetic Sampling, Gravimetric Method ⁽³⁾ |
| 16 | Xylene | Absorption Sampling, Gas Chromatographic Method ⁽³⁾ |

สิ่งบ่งชี้...

(นายวิภากร บุญ อัครสกุลวิไล)
ผู้อำนวยการศูนย์มาตรฐานวิชาการกองกลางจังหวัดขอนแก่น
และศูนย์มาตรฐานวิชาการ

สิ่งบ่งชี้ของหรือวัตถุที่ไม่ใช่แล้ว จำนวน 35 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-----------|--|
| 1 | Aldrin | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ⁽¹⁾⁽⁴⁾⁽²⁾ 2) Soxhlet Extraction, Gas Chromatographic Method ⁽¹⁾⁽²⁾⁽³⁾ 3) Automated Soxhlet Extraction, Gas Chromatographic Method ⁽²⁾⁽³⁾⁽¹⁾ |
| 2 | Antimony | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ⁽¹⁾⁽⁴⁾⁽³⁾ 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁽¹⁾⁽⁴⁾⁽³⁾ 3) Digestion, Inductively Coupled Plasma Method ⁽⁷⁾⁽¹⁾⁽³⁾ 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁷⁾⁽¹⁾⁽³⁾ |
| 3 | Arsenic | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ⁽¹⁾⁽⁴⁾⁽³⁾ 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁽¹⁾⁽⁴⁾⁽³⁾ 3) Digestion, Inductively Coupled Plasma Method ⁽⁷⁾⁽¹⁾⁽³⁾ 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁷⁾⁽¹⁾⁽³⁾ |
| 4 | Barium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ⁽¹⁾⁽⁴⁾⁽³⁾ 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁽¹⁾⁽⁴⁾⁽³⁾ 3) Digestion, Inductively Coupled Plasma Method ⁽⁷⁾⁽¹⁾⁽³⁾ 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁷⁾⁽¹⁾⁽³⁾ |
| 5 | Beryllium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ⁽¹⁾⁽⁴⁾⁽³⁾ 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ⁽¹⁾⁽⁴⁾⁽³⁾ 3) Digestion, Inductively Coupled Plasma Method ⁽⁷⁾⁽¹⁾⁽³⁾ 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ⁽⁷⁾⁽¹⁾⁽³⁾ |

6 Cadmium...

(นายวิภากร บุญ อัครสกุลวิไล)
ผู้อำนวยการศูนย์มาตรฐานวิชาการกองกลางจังหวัดขอนแก่น
และศูนย์มาตรฐานวิชาการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------------|--|
| 6 | Cadmium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.13) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.14) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |
| 7 | Chlordane | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 8 | Chromium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.15) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.16) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |
| 9 | Chromium (III) | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation Method ^(3.6.15.17) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation Method ^(1.6.16.17) 3) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7.15.17) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7.16.17) |
| 10 | Chromium (VI) | 1) Waste Extraction, Colorimetric Method ^(1.6.17) 2) Alkaline Digestion, Colorimetric Method ^(1.6.17) |

วิธีแปล
(นางวิภาดา ชัยพรกุลกิจ)

1.1 Cobalt...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 11 | Cobalt | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.13) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.14) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |
| 12 | Copper | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.13) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.14) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |
| 13 | 2,4-D | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 14 | DDO | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 15 | DDE | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 16 | DOT | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) |

วิธีแปล
(นางวิภาดา ชัยพรกุลกิจ)

2) Soxhlet...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|------------|--|
| 17 | Dieldrin | 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 18 | Endrin | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 19 | Heptachlor | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 20 | Lead | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.13) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.14) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |
| 21 | Lindane | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 22 | Mercury | 1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^(1.6.18) |

วิธีแปล
(นางวิภาดา ชัยพรกุลกิจ)

2) Waste Extraction...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|--------------|--|
| 23 | Methoxychlor | 2) Waste Extraction, Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method ^(1.6.19) 3) Waste Extraction, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^(1.6.20) 4) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^(1.6) 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method ^(1.6) 6) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^(1.6) |
| 24 | Mirex | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1.9.25) 2) Soxhlet Extraction, Gas Chromatographic Method ^(10.22) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(10.23) |
| 25 | Molybdenum | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.13) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.14) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |
| 26 | Nickel | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1.6.13) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1.6.14) 3) Digestion, Inductively Coupled Plasma Method ^(7.15) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7.16) |

วิธีแปล
(นางวิภาดา ชัยพรกุลกิจ)

27 Polychlorinated...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---|--|
| 27 | Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,3-Dichlorobiphenyl - 2,2',5-Trichlorobiphenyl - 2,4',5-Trichlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5-Pentachlorobiphenyl - 2,2',4,5,5-Pentachlorobiphenyl - 2,3,3',4,6-Pentachlorobiphenyl - 2,2',3,4,4,5-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5,6'-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6'-Octachlorobiphenyl - 2,2',3,3',4,4',5,5',6,6'-Nonachlorobiphenyl | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method ^(1,9,23) 2) Soxhlet Extraction, Gas Chromatographic Method ^(1,9,23) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(22,31) |

Signature
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ผู้อำนวยการศูนย์วิจัยการวิเคราะห์มลพิษทางอากาศ

28 Pentachlorophenol...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-------------------|--|
| 28 | Pentachlorophenol | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1,9,23) 2) Soxhlet Extraction, Gas Chromatographic Method ^(1,9,23) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(22,31) |
| 29 | pH | Electrometric Method ^(23,30) |
| 30 | Selenium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,4,15) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,4,16) 3) Digestion, Inductively Coupled Plasma Method ^(7,13) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |
| 31 | Silver | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,4,15) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,4,16) |
| 32 | Thallium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,4,15) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,4,16) 3) Digestion, Inductively Coupled Plasma Method ^(7,13) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |
| 33 | Toxaphene | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^(1,9,23) 2) Soxhlet Extraction, Gas Chromatographic Method ^(1,9,23) 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^(22,31) |
| 34 | Vanadium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,4,15) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,4,16) 3) Digestion, Inductively Coupled Plasma Method ^(7,13) |

Signature
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4) Digestion...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 35 | Zinc | 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,4,16) 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^(1,4,15) 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(1,4,16) 3) Digestion, Inductively Coupled Plasma Method ^(7,13) 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |

สืบ จำนวน 125 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|--------------|---|
| 1 | Acenaphthene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 2 | Acetone | Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(14,24) |
| 3 | Aldrin | 1) Soxhlet Extraction, Gas Chromatographic Method ^(13,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 4 | Anthracene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 5 | Antimony | 1) Digestion, Inductively Coupled Plasma Method ^(7,13) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |
| 6 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method ^(7,13) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |
| 7 | Atrazine | 1) Soxhlet Extraction, Gas Chromatographic Method ^(13,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 8 | Barium | 1) Digestion, Inductively Coupled Plasma Method ^(7,13) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |

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9 Benz(a)anthracene...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------------------------|---|
| 9 | Benz(a)anthracene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 10 | Benzene | Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(14,24) |
| 11 | Benzo(b)fluoranthene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 12 | Benzo(k)fluoranthene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 13 | Benzoic acid | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 14 | Benzo(a)pyrene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 15 | Benzo(g,h,i)perylene | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 16 | Beryllium | 1) Digestion, Inductively Coupled Plasma Method ^(7,13) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |
| 17 | Bis(2-chloroethyl)ether | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 18 | Bis(2-ethylhexyl)phthalate | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 19 | Bromodichloromethane | Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(14,24) |
| 20 | Bromoform | Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(14,24) |
| 21 | Butanol | Equilibrium Headspace, Gas Chromatographic/Mass Spectrometric Method ^(12,24) |
| 22 | Butyl Benzyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 23 | Cadmium | 1) Digestion, Inductively Coupled Plasma Method ^(7,13) 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^(7,14) |
| 24 | Carbazole | Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method ^(25,31) |
| 25 | Carbon Disulfide | Purge and Trap, Gas Chromatographic/Mass Spectrometric Method ^(14,24) |

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26 Carbon tetrachloride...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|----------------------|--|
| 26 | Carbon tetrachloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 27 | Chloridane | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 28 | p-Chloroaniline | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 29 | Chlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 30 | Chlorodibromomethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 31 | Chloroform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 32 | 2-Chlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 33 | Chromium | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,16) |
| 34 | Chromium (III) | 1) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7,15,17) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^(7,16,17) |
| 35 | Chromium (VI) | Alkaline Digestion, Colorimetric Method ^(11,17) |
| 36 | Chrysene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 37 | Cyanide | Extraction, Distillation, Colorimetric Method ^(28,27,18) |
| 38 | 2,4-D | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 39 | DDD | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |

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40 DOE...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|----------------------------|---|
| 40 | DDE | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 41 | DDT | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 42 | Dibenz(a,h)anthracene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 43 | Di-n-Butyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 44 | 1,2-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 45 | 1,3-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 46 | 1,4-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 47 | 3,3-Dichlorobenzidine | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 48 | 1,1-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 49 | 1,2-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 50 | 1,1-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 51 | cis-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 52 | trans-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 53 | 2,4-Dichlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 54 | 1,2-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 55 | 1,3-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 56 | 1,3-Dichloropropene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |

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57 Dieldrin...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|----------------------|---|
| 57 | Dieldrin | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 58 | Diethyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 59 | 2,4-Dimethylphenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 60 | 2,4-Dinitrophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 61 | 2,4-Dinitrotoluene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 62 | 2,6-Dinitrotoluene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 63 | Di-n-Octyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 64 | Endosulfan | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 65 | Endrin | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 66 | Ethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 67 | Fluoranthene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 68 | Fluorene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 69 | Heptachlor | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 70 | Heptachlor Epoxide | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |

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71 Hexachlorobenzene...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|---------------------------|---|
| 71 | Hexachlorobenzene | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 72 | Hexachloro-1,3-butadiene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 73 | n-Hexane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 74 | α-HCH | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 75 | β-HCH | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 76 | γ-HCH | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(10,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 77 | Hexachlorocyclopentadiene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 78 | Hexachloroethane | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 79 | Indeno(1,2,3-cd)pyrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 80 | Isophorone | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 81 | Lead | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,16) |
| 82 | Manganese | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,16) |
| 83 | Mercury | 1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ⁽¹⁴⁾ |

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2) Thermal...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|--|--|
| 84 | Methanol | 2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry ⁽¹³⁾ 3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ⁽²⁰⁾ |
| 85 | Methoxychlor | Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^(12,24) 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(16,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 86 | Methyl Bromide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 87 | Methylene Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 88 | 2-methylphenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 89 | 2-Methylnaphthalene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 90 | Methyl tert-Butyl Ether | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 91 | Naphthalene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 92 | Nickel | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,14) |
| 93 | Nitrobenzene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 94 | N-Nitrosodiphenylamine | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 95 | N-Nitrosodi-n-propylamine | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 96 | Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 | 1) Soxhlet Extraction, Gas Chromatographic Method ^(16,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Method ^(25,31) |

สำนักงานสิ่งแวดล้อมแห่งชาติ
ศูนย์ปฏิบัติการจัดการมลพิษทางอากาศ

- Aroclor 1242 -

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|--|--|
| | - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2,3,4,5-Pentachlorobiphenyl - 2,2,4,5,5-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2,3,4,4',5-Hexachlorobiphenyl - 2,2,3,4,5,5-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl | |
| 97 | Pentachlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 98 | Phenanthrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 99 | Phenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 100 | Pyrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |

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101 Selenium...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|---|---|
| 101 | Selenium | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,14) |
| 102 | Silver | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,14) |
| 103 | Styrene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 104 | 1,1,2,2-Tetrachloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 105 | Tetrachloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 106 | Toluene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 107 | Toxaphene | 1) Soxhlet Extraction, Gas Chromatographic/ Method ^(16,22) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 108 | TPH (C ₈ -C ₆) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 109 | TPH (C ₉ -C ₁₄) | 1) Solvent Extraction, Gas Chromatographic Method ^(13,21) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Method ^(25,31) |
| 110 | TPH (C ₁₅ -C ₃₃) | 1) Solvent Extraction, Gas Chromatographic Method ^(13,21) 2) Automated Soxhlet Extraction, Gas Chromatographic/ Method ^(25,31) |
| 111 | 1,2,4-Trichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 112 | 1,1,1-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 113 | 1,1,2-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 114 | Trichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 115 | 2,4,5-Trichlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |

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116 2,4,6-Trichlorophenol...

| ลำดับที่ | สารเคมี | วิธีวิเคราะห์ |
|----------|------------------------|---|
| 116 | 2,4,6-Trichlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^(25,31) |
| 117 | 1,3,5-Trimethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 118 | Vanadium | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,14) |
| 119 | Vinyl Acetate | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 120 | Vinyl Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 121 | m-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 122 | o-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 123 | p-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 124 | Xylene (Total) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^(14,24) |
| 125 | Zinc | 1) Digestion, Inductively Coupled Plasma Method ^(7,15) 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^(7,14) |


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ศูนย์ปฏิบัติการจัดการมลพิษทางอากาศ


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(นางสาวณัฐพร ชันธนา)
ผู้อำนวยการศูนย์ปฏิบัติการและทดสอบ
กรมโรงงานอุตสาหกรรม
กระทรวงอุตสาหกรรม

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(นางสาวณัฐพร ชันธนา)
ผู้อำนวยการศูนย์ปฏิบัติการและทดสอบ
กรมโรงงานอุตสาหกรรม
กระทรวงอุตสาหกรรม

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบและประเมินผลปฏิบัติการ การวัดและประเมินผลสิ่งปนเปื้อน กรมโรงงานอุตสาหกรรม โทร. ๐ ๒๒๒๒ ๔๐๐๒๕, ๔๐๐๒๖



ที่ จอ.๐๐๑๑๑/๑๖.๕.๒๕๖๒

กรมโรงงานอุตสาหกรรม
ถนนพหลโยธิน กม.๑๖ จ.นนทบุรี กรุงเทพฯ ๑๑๐๐๐

๐ ๕ มีนาคม ๒๕๖๒

เรื่อง (เปลี่ยน) ผลการตรวจประเมินปฏิบัติการวิเคราะห์

เรียน กรรมการผู้พิจารณา บริษัท เอเชีย อีเลคทรอนิกส์ จำกัด (ประเทศไทย) จำกัด

อ้างถึง หนังสือแนบมา/ข้อมูล/ใบเสนอผลการตรวจ และหนังสือขอประเมินปฏิบัติการวิเคราะห์

เมื่อวันที่ ๕ กุมภาพันธ์ ๒๕๖๒

ตามที่บริษัท เอเชีย อีเลคทรอนิกส์ จำกัด (ประเทศไทย) จำกัด ขอประเมินปฏิบัติการวิเคราะห์

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว มีความเห็นดังนี้

๑. ให้ยกเลิกการประเมินปฏิบัติการวิเคราะห์ จำนวน ๑๒ รายการ

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| ๑) นายสมชาย สุขเจริญ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๒) นายสุเมธ นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๓) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๔) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๕) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๖) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๗) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๘) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๙) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๐) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๑) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๒) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๓) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๔) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๕) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๖) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๗) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๘) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๑๙) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๒๐) นายสมชาย นามวงศ์ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |

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๒. ให้เพิ่มเจ้าหน้าที่

๒. ให้เพิ่มเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ ราย

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| ๑) นายสมชาย สุขเจริญ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๒) นายสมชาย สุขเจริญ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๓) นายสมชาย สุขเจริญ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๔) นายสมชาย สุขเจริญ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |
| ๕) นายสมชาย สุขเจริญ | ประเมินผลที่ ๖๐๑๔-๖๐๑๕ |

๖) นายสมชาย สุขเจริญ

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๖) นายสมชาย สุขเจริญ

ที่ ๖๓.๐๓๑๓(๓)/ ๖๒๒ ๕



กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒๓ มิถุนายน ๒๕๖๖

เรื่อง เปลี่ยนแปลงบุคลากรของห้องปฏิบัติการวิเคราะห์

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขออนุญาตขอห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๓๐ มีนาคม ๒๕๖๖

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด
ต้องปฏิบัติตามการวิเคราะห์เอกชน เลขทะเบียน ๖-๒๐๑๔ สถานที่ตั้งเลขที่ ๓๐๔ ซอยพัฒนาการ ๕๐
ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ขอเปลี่ยนแปลงบุคลากรของห้องปฏิบัติการ
วิเคราะห์ การตามติดแจ้งแล้ว นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้เปลี่ยนแปลงชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการ
วิเคราะห์ จันทิมา นาสารณศิริ มงคลเจริญดี ทะเบียนเลขที่ ๖-๒๐๑๔-๔๗๖๒ เป็น นาสารณศิริ มงคลเจริญดี
ทะเบียนเลขที่ ๖-๒๐๑๔-๔๗๖๓

ทั้งนี้ หากท่านมีความประสงค์จะยื่นคำขอใดๆ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์
ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม ตาม QR Code ที่แนบมาด้วย

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

๒๓ มิถุนายน ๒๕๖๖

(นายประทีป คำพรหม)
ผู้อำนวยการกองวิเคราะห์และสิ่งแวดล้อม
ปฏิบัติการทางเคมีและชีวเคมี กรมโรงงานอุตสาหกรรม

กองวิจัยและพัฒนาศักยภาพโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๕๖๑ ๖๓๒๒ ต่อ ๒๐๑๓-๕

โทรสาร ๐ ๒๕๖๑ ๖๓๒๒ ต่อ ๒๐๑๔

ไปรษณีย์อิเล็กทรอนิกส์ sarabangdwin@mail.go.th



ยื่นคำขอผ่านระบบอิเล็กทรอนิกส์



ที่ ๖๓.๐๓๑๓(๓)/ ๖๔๗๐



กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๕๐๐

๒๔ มิถุนายน ๒๕๖๖

เรื่อง ขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และขออนุญาตขอห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๒๔ เมษายน ๒๕๖๔

สิ่งที่ส่งมาด้วย เอกสารแนบท้ายหนังสือขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด จำนวน ๒ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอขึ้นทะเบียน
ห้องปฏิบัติการวิเคราะห์เอกชน หรือรายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ เจ้าหน้าที่ประจำ
ห้องปฏิบัติการวิเคราะห์ และรายการสารสนเทศที่จะทำการวิเคราะห์ ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป
(ประเทศไทย) จำกัด ขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน มีเลขทะเบียน ๖-๒๐๒๔ สถานที่ตั้งเลขที่
๖๒๖/๑๐ หมู่ที่ ๕ ตำบลแม่ไม้คู่ อำเภอปลวกแดง จังหวัดระยอง โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์

| | |
|--------------------------|---------------------------|
| ๑) นายเดช ช้างชน | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๒ |
| ๒) นางวิลาวัลย์ บริรักษ์ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๓ |
| ๓) นายสุพจน์ สยามะดี | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๔ |

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์

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| ๑) นางสาวณัฐพร บรรจงกิจ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๕ |
| ๒) นางพณณา สีดา | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๖ |
| ๓) นางสาวรณิศา กุลศิริวงศ์ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๗ |
| ๔) นายพิชชา ทองแดง | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๘ |
| ๕) นางศศิธรา สุบงษ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๙ |
| ๖) จ.ท.ร.ม.ชัย ม่วงมา | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๐ |
| ๗) นายวรารุณ ทับพา | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๑ |
| ๘) นายศักดิ์รินทร์ จรุงกัญ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๒ |
| ๙) นายสุรศักดิ์ สาทิน | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๓ |
| ๑๐) นางสาวเพชรคุณ ภาณุพานนท์ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๔ |
| ๑๑) นายสุภากร ภาณุทวี | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๕ |
| ๑๒) นายสุวิทย์คำวงศ์ โชคดีสินธุ์ | ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๗๖ |

๑๓) นายวิมล...

๑๓) นายวิมล...

๑๔) นางสาวรณิศา...

๑๕) นางสาวรณิศา...

๑๖) นายณัฐพร...

๑๗) นายสุพจน์...

๑๘) นายสุพจน์...

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๔๐) นายสุพจน์...

ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๖๕

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ทะเบียนเลขที่ ๖-๒๐๒๔-๔๗๙๒

๑. ขอขยายสารเคมีที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๑๔ รายการ

จากหนังสือ (ปล่องระบาย) จำนวน ๔ รายการ และน้ำใต้ดิน จำนวน ๓ รายการ รวมทั้งสิ้นจำนวน ๑๙ รายการ
ตามหนังสือแนบมาด้วย

หนังสือแนบมาด้วย ๓ ปี นับจากวันที่กรมโรงงานอุตสาหกรรมออกหนังสือ หากประสงค์
จะต่ออายุหนังสือขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุหรือเอกสารประกอบ
คำขอต่อกรมโรงงานอุตสาหกรรมภายใน ๓๐ วัน (นับวันที่อายุของหนังสือขึ้นทะเบียนหมดอายุ)
ในระหว่างเอกสารชี้แจงคำขอต่ออายุที่ส่งมาจะยังไม่ได้รับอนุญาตให้ดำเนินการโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

๒๔ มิถุนายน ๒๕๖๖

(นายประทีป คำพรหม)
ผู้อำนวยการกองวิเคราะห์และสิ่งแวดล้อม
ปฏิบัติการทางเคมีและชีวเคมี กรมโรงงานอุตสาหกรรม

กองวิจัยและพัฒนาศักยภาพโรงงาน

ศูนย์วิจัยและพัฒนาศักยภาพโรงงานภาคตะวันออก

โทร. ๐ ๒๕๖๕ ๔๒๒๓-๓

ไปรษณีย์อิเล็กทรอนิกส์ samai@w.go.th

เอกสารแนบท้ายหนังสือรับข้อเสนอยุทธศาสตร์การวิเคราะห์
บริษัท เอนแอส แอสเทรทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ๖-๗๒๓
ที่ ๑๓ ๐๓๑๐(๓)/ ๒๔ ๗๐ ลงวันที่ ๒๔ มิถุนายน ๒๕๖๕

ขอขยายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๒๔ รายการ
เป็นสิบ จำนวน 14 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---------------------------|--|
| 1 | Biochemical Oxygen Demand | 1) 5 Day BOD Test, Membrane Electrode Method ⁽²⁾ 2) 5 Day BOD Test, Azide Modification Method ⁽³⁾ |
| 2 | Chemical Oxygen Demand | 1) Open Reflux, Titrimetric Method ⁽²⁾ 2) Closed Reflux, Colorimetric Method ⁽²⁾ 3) Closed Reflux, Titrimetric Method ⁽²⁾ |
| 3 | Color | ADMI Weighted - Ordinate Spectrophotometric Method ⁽¹⁾ |
| 4 | Cyanide | Distillation, Colorimetric Method ⁽²⁾ |
| 5 | Formaldehyde | Distillation, Colorimetric Method ⁽¹⁾ |
| 6 | Free Chlorine | DPD-Ferrous Titrimetric Method ⁽²⁾ |
| 7 | Oil and Grease | Liquid Liquid Partition-Gravimetric Method ⁽²⁾ |
| 8 | pH | Electrometric Method ⁽²⁾ |
| 9 | Phenols | 1) Distillation, Chloroform Extraction Method ⁽¹⁾ 2) Distillation, Direct Photometric Method ⁽²⁾ |
| 10 | Sulfide | ZnS Precipitation, Iodometric Method ⁽²⁾ |
| 11 | Temperature | Laboratory and Field Method ⁽²⁾ |
| 12 | Total Dissolved Solids | Dried at 180 °C ⁽²⁾ |
| 13 | Total Kjeldahl Nitrogen | Semi-Micro Kjeldahl Method ⁽²⁾ |
| 14 | Total Suspended Solids | Dried at 103-105 °C ⁽²⁾ |

อากาศเสีย (ต่อเนื่องตาม) จำนวน 7 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-------------------|--|
| 1 | Carbon Monoxide | 1) Sampling Bag, Non-Dispersive Infrared Method ⁽³⁾ 2) Instrumental Analyzer Method ⁽⁸⁾ |
| 2 | Hydrogen Sulfide | Absorption Sampling, Iodometric Method ⁽³⁾ |
| 3 | Opacity | Ringelmann's Method ^(3,8) |
| 4 | Oxide of Nitrogen | 1) Absorption Sampling, Phenoldisulfonic Acid Method ⁽⁶⁾ 2) Instrumental Analyzer Method ⁽⁹⁾ |
| 5 | Sulfur Dioxide | 1) Absorption Sampling, Barium-Thoron Titrimetric Method ⁽⁵⁾ 2) Instrumental Analyzer Method ⁽¹⁰⁾ |

วิรัตน์ สิมะกุล
(นางสาววิชุดา สิมะกุล)
ผู้อำนวยการ
ศูนย์วิจัยและพัฒนากายมลพิษโรงงานภาคตะวันออก Sulfuric Acid...

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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-----------------------------|--|
| 6 | Sulfuric Acid | Isokinetic Sampling, Barium - Thorin Titrimetric Method ⁽⁴⁾ |
| 7 | Total Suspended Particulate | Isokinetic Sampling, Gravimetric Method ⁽⁷⁾ |

น้ำใต้ดิน จำนวน 3 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 1 | Cyanide | Distillation, Colorimetric Method ⁽⁵⁾ |
| 2 | pH | Electrometric Method ⁽²⁾ |
| 3 | Phenols | Distillation, Direct Photometric Method ⁽⁴⁾ |

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วิรัตน์ สิมะกุล
(นางสาววิชุดา สิมะกุล)
ผู้อำนวยการ
ศูนย์วิจัยและพัฒนากายมลพิษโรงงานภาคตะวันออก
ศูนย์วิจัยและพัฒนากายมลพิษโรงงานภาคตะวันออก 40 วิจัยและพัฒนากายมลพิษโรงงาน กรมโรงงานอุตสาหกรรม โทร ๐ ๗๔๐-๔ ๗๒๓๓๓