

ภาคผนวก ง

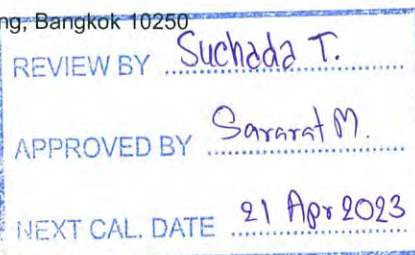
ใบรับรองการสอบเทียบเครื่องมือ

Certificate of System Qualification

GC-OQ

System ID: GC-6
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phattanakan 40, Phattanakan Rd., Suan Luang, Bangkok 10250

Date: October 21, 2021 10:05:40 AM
EQP Name: AgilentRecommended
EQP Revision: GC.02.50
Overall Qualification Status: Pass



System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: 0.0 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

Setpoint Status:

Pass

| | Setpoint | | Actual | |
|----------------------|----------|-----|--------|-----|
| Inlet Pressure: | 25.0 | psi | 24.9 | psi |
| Accuracy: | | | 0.1 | psi |
| Agilent Recommended: | | | <= 1.2 | |

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Name:

7890

Back

SSL

Setpoint Status:

Pass

Pressure:

25.0 psi

Pressure Change:

0.0 psi /5 minutes

Agilent Recommended:

>= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name:

7890

Back

SSL

Setpoint Status:

Pass

| | Setpoint | | Actual | |
|----------------------|----------|-----|--------|-----|
| Inlet Pressure: | 25.0 | psi | 24.9 | psi |
| Accuracy: | | | 0.1 | psi |
| Agilent Recommended: | | | <= 1.2 | |

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

Name: 7890

Front FID

Setpoint Status: Pass

Flow Type: Fuel

Setpoint: 30.0 mL/min Measured Flow: 30.5 mL/min

Accuracy: 0.5 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (3.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Oxidizer

Setpoint: 400.0 mL/min Measured Flow: 394.0 mL/min

Accuracy: 6.0 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (40.0 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Makeup

Setpoint: 25.0 mL/min Measured Flow: 24.2 mL/min

Accuracy: 0.8 mL/min

Agilent Recommended: ≤ 10.0 % setpoint (2.5 mL/min)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Back FID

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

230.0 231.5 °C

Accuracy:

1.5 °C

Agilent Recommended:

>= -1.0 % setpoint in K (-5.0 °C)

<= 1.0 % setpoint in K (5.0 °C)

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

100.0 100.5 °C

Accuracy:

0.5 °C

Agilent Recommended:

>= -1.0 % setpoint in K (-3.7 °C)

<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:

7890

Setpoint Status:

Pass

Setpoint/Average

Temperature:

100.0 100.4667 °C

Stability:

0.1 °C

Agilent Recommended:

<= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1

Front

SSL

/ Front

FID

Injection Tower

Name:

7693A

Date:

October 21, 2021 10:05:40 AM

System ID:

GC-6

Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1 Front SSL / Front FID

Name: 7890

Setpoint Status: Pass

Base Signal: 12.7 pA

ASTM Noise

pA

0.06

<= 0.10

Pass

Drift

pA/Hr

0.10

<= 2.50

Pass

Agilent Recommended:

Status:

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1 Front SSL / Front FID

Name: 7693A

Setpoint Status: Pass

Injection Volume on Column: 1.0 uL

Area RSD: 0.42 % Retention Time RSD: 0.16 %

Agilent Recommended: <= 3.00 <= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

Tested Combination1 Front SSL / Front FID

Injection Tower

Name: 7890

Setpoint Status: Pass

Signal to Noise: 1174861

Agilent Recommended: >= 300000

Overall Signal to Noise Test Status

Pass

Scouting Run

Tested Combination2 Back SSL / Back FID

Injection Tower

Name: 7693A

Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination2 Back SSL / Back FID

Name: 7890

Setpoint Status: Pass

Base Signal: 10.4 pA

ASTM Noise

pA

0.05

Agilent Recommended:

<= 0.10

Status:

Pass

Drift

pA/Hr

0.00

<= 2.50

Pass

Date: October 21, 2021 10:05:40 AM

System ID: GC-6

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2

Back

SSL

/ Back

FID

Name:

7693A

Setpoint Status:

Pass

Injection Volume on Column:

1.0

uL

Area RSD:

1.16

%

Retention Time RSD:

0.12

%

Agilent Recommended:

<=

3.00

<=

1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2

Back

SSL

/ Back

FID

Injection Tower

Name:

7890

Setpoint Status:

Pass

Signal to Noise:

805466

Agilent Recommended:

>=

300000

Overall Signal to Noise Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

| | |
|------------------------|-----------------------------------|
| System ID | GC-6 |
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Flow Data Input | Manual Data |
| Temperature Data Input | Manual Data or Other Data Logging |

Tested Combination1

| | |
|---------------------|-----------------|
| Injection Technique | Injection Tower |
| Sampler Identifier | Sampler 2 |
| Inlet | Front |
| Detector | Front |
| LTM Included? | No |

Tested Combination2

| | |
|---------------------|-----------------|
| Injection Technique | Injection Tower |
| Sampler Identifier | Sampler 3 |
| Inlet | Back |
| Detector | Back |
| LTM Included? | No |

Sampler 1

| | |
|-------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Tray |
| Name | 7693A |
| Model Number | G4514A |
| Serial Number | CN15380030 |
| Firmware Revision | A.11.01 |
| Vial Heater | Not installed |

Sampler 2

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Injection Tower |
| Name | 7693A |
| Model Number | G4513A |
| Serial Number | CN10340103 |
| Firmware Revision | A.10.09 |
| Usage | Sample Injection |
| Location | Front |
| Syringe Volume (µL) | 10 |

Sampler 3

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Injection Tower |
| Name | 7693A |
| Model Number | G4513A |
| Serial Number | CN16280128 |
| Firmware Revision | A.10.09 |
| Usage | Sample Injection |
| Location | Back |
| Syringe Volume (µL) | 10 |

Mainframe 1

| | |
|------------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Model Number | G3440A |
| Serial Number | CN11461066 |
| Firmware Revision | Version 4.27 |
| Component ID/Asset No. | GC-6 |
| Oven Type | Standard |

Inlet 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | SSL |
| Location | Front |
| Carrier Gas | Helium |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes |

Inlet 2

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | SSL |
| Location | Back |
| Carrier Gas | Helium |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes |

Detector 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | FID |
| Adapter | Capillary |
| Control Type | Electronic Pressure Control (EPC) |
| Location | Front |
| Makeup Gas | Nitrogen |

Detector 2

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | FID |
| Adapter | Capillary |
| Control Type | Electronic Pressure Control (EPC) |
| Location | Back |
| Makeup Gas | Nitrogen |

Electronic Signature

Purpose

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Details

| | |
|--------------------------|---|
| Full Name of Signer: | Suriya Thongkaew |
| Logged On User Name: | suriya.thongkaew@non.agilent.com |
| Signature Creation Date: | October 21, 2021 |
| Reason for Signature: | Executed protocol and published this original version of document |

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User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|---|--|
| October 20, 2021 12:18:50 PM | Audit | SessionCreated | Session | None |
| October 20, 2021 12:18:50 PM | Start | Configuration | Session | None |
| October 20, 2021 12:18:50 PM | Audit | Entitlement | Licensing | User is Nonpaying and does not require an unlock code |
| October 20, 2021 12:24:57 PM | Audit | EqpLoaded | Session | EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.51/Gc.02.51.eqp], EQP File Name: [Gc.02.51.eqp], EQP Name: [AgilentRecommended] |
| October 20, 2021 12:25:02 PM | End | Configuration | Session | None |
| October 20, 2021 12:25:09 PM | Start | Qualification | Session | OQ |
| October 20, 2021 12:25:09 PM | Start | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | None |
| October 20, 2021 12:30:25 PM | End | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | Run Count : 1 |
| October 20, 2021 12:56:29 PM | Start | Execution | Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | None |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|---|----------------------|
| October 20, 2021 1:02:16 PM | End | Execution | Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | Run Count : 1 |
| October 20, 2021 1:02:18 PM | Start | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | None |
| October 20, 2021 1:02:26 PM | End | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | Run Count : 1 |
| October 20, 2021 1:02:29 PM | Start | Execution | Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | None |
| October 20, 2021 1:04:21 PM | End | Execution | Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | Run Count : 1 |
| October 20, 2021 1:07:53 PM | Start | Execution | Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | None |
| October 20, 2021 1:08:11 PM | End | Execution | Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | Run Count : 1 |
| October 20, 2021 1:08:16 PM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | None |
| October 20, 2021 1:20:23 PM | Audit | Data | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 20, 2021 1:20:26 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |

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User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|--|----------------------|
| October 20, 2021 1:20:29 PM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | None |
| October 20, 2021 1:23:27 PM | Audit | Data | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 20, 2021 1:23:29 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 20, 2021 1:23:31 PM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | None |
| October 20, 2021 1:27:40 PM | Audit | Data | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 20, 2021 1:27:42 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 20, 2021 1:27:46 PM | Start | Execution | Detector Flow Accuracy - Back FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | None |
| October 20, 2021 1:32:10 PM | Audit | Data | Detector Flow Accuracy - Back FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 20, 2021 1:32:12 PM | End | Execution | Detector Flow Accuracy - Back FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 20, 2021 1:32:14 PM | Start | Execution | Detector Flow Accuracy - Back FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | None |
| October 20, 2021 1:34:13 PM | Audit | Data | Detector Flow Accuracy - Back FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |

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User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKkW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|---|----------------------|
| October 20, 2021 1:34:16 PM | End | Execution | Detector Flow Accuracy - Back FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 20, 2021 1:34:46 PM | Start | Execution | Detector Flow Accuracy - Back FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | None |
| October 20, 2021 1:36:33 PM | Audit | Data | Detector Flow Accuracy - Back FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 20, 2021 1:36:36 PM | End | Execution | Detector Flow Accuracy - Back FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 20, 2021 1:36:38 PM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| October 20, 2021 2:04:31 PM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| October 20, 2021 2:04:32 PM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| October 20, 2021 2:04:34 PM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| October 20, 2021 2:10:47 PM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|--|----------------------|
| October 20, 2021 2:10:49 PM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| October 20, 2021 2:10:51 PM | Start | Execution | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | None |
| October 20, 2021 2:31:39 PM | Audit | Data | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | Manual Data Entry |
| October 20, 2021 2:31:41 PM | End | Execution | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | Run Count : 1 |
| October 20, 2021 2:31:44 PM | Start | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | None |
| October 20, 2021 2:43:06 PM | Audit | AceClosed | Session | None |
| October 21, 2021 9:18:59 AM | Audit | AceRestarted | Session | None |
| October 21, 2021 9:19:02 AM | Audit | SessionReloaded | Session | None |
| October 21, 2021 9:19:09 AM | Start | Qualification | Session | OQ |
| October 21, 2021 9:19:09 AM | Start | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | None |
| October 21, 2021 9:19:41 AM | Audit | AceClosed | Session | None |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|---|---|
| October 21, 2021 9:20:08 AM | Audit | AceRestarted | Session | None |
| October 21, 2021 9:20:09 AM | Audit | SessionReloaded | Session | None |
| October 21, 2021 9:20:13 AM | Start | Qualification | Session | OQ |
| October 21, 2021 9:20:13 AM | Start | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | None |
| October 21, 2021 9:29:45 AM | Audit | Data | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_F 2021-10-20 15-49-01\SCOUT_F001.D\FI D1A.ch |
| October 21, 2021 9:30:05 AM | End | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | Run Count : 1 |
| October 21, 2021 9:30:08 AM | Start | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | None |
| October 21, 2021 9:30:41 AM | Audit | Data | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_F 2021-10-20 15-49-01\SIGNSDRF_F001. D\FID1A.ch |
| October 21, 2021 9:31:10 AM | End | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Run Count : 1 |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|--|--|
| October 21, 2021 9:31:42 AM | Start | Execution | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | None |
| October 21, 2021 9:32:55 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_F 2021-10-20 16-51-16\INJPREC_F002.D\FID1A.ch |
| October 21, 2021 9:32:55 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_F 2021-10-20 16-51-16\INJPREC_F003.D\FID1A.ch |
| October 21, 2021 9:32:56 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_F 2021-10-20 16-51-16\INJPREC_F004.D\FID1A.ch |
| October 21, 2021 9:32:56 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_F 2021-10-20 16-51-16\INJPREC_F005.D\FID1A.ch |
| October 21, 2021 9:32:56 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_F 2021-10-20 16-51-16\INJPREC_F006.D\FID1A.ch |
| October 21, 2021 9:32:56 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_F 2021-10-20 16-51-16\INJPREC_F007.D\FID1A.ch |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|---|--|
| October 21, 2021 9:33:07 AM | End | Execution | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Run Count : 1 |
| October 21, 2021 9:33:23 AM | Start | Execution | Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000 | None |
| October 21, 2021 9:34:01 AM | Audit | Data | Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000 | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_F 2021-10-20 16-51-16\SIGTONS_F001.D\FID1A.ch |
| October 21, 2021 9:34:15 AM | End | Execution | Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000 | Run Count : 1 |
| October 21, 2021 9:34:19 AM | Start | Execution | GC Scouting Run - Injection Tower, Back SSL, Back FID: - Part of System Preparation - No limits associated | None |
| October 21, 2021 9:35:04 AM | Audit | Data | GC Scouting Run - Injection Tower, Back SSL, Back FID: - Part of System Preparation - No limits associated | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_B 2021-10-20 17-13-45\SCOUT_B001.D\FID1A.ch |
| October 21, 2021 9:35:27 AM | End | Execution | GC Scouting Run - Injection Tower, Back SSL, Back FID: - Part of System Preparation - No limits associated | Run Count : 1 |
| October 21, 2021 9:35:32 AM | Start | Execution | Noise and Drift - Back FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | None |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|---|--|
| October 21, 2021 9:36:06 AM | Audit | Data | Noise and Drift - Back FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_B 2021-10-20 17-13-45\SIGNSDRF_B001.D\FID2B.ch |
| October 21, 2021 9:36:16 AM | End | Execution | Noise and Drift - Back FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Run Count : 1 |
| October 21, 2021 9:36:20 AM | Start | Execution | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | None |
| October 21, 2021 9:38:57 AM | Audit | Data | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_B 2021-10-20 17-13-45\INJPREC_B002.D\FID2B.ch |
| October 21, 2021 9:38:57 AM | Audit | Data | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_B 2021-10-20 17-13-45\INJPREC_B003.D\FID2B.ch |
| October 21, 2021 9:38:57 AM | Audit | Data | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_B 2021-10-20 17-13-45\INJPREC_B004.D\FID2B.ch |
| October 21, 2021 9:38:57 AM | Audit | Data | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021_B 2021-10-20 17-13-45\INJPREC_B005.D\FID2B.ch |

User Name: suriya.thongkaew

System Id: GC-6

Hostname: ASBKKW7015

Print Date: October 21, 2021 10:05:46 AM

OQ GC ALS CN11461066 Transaction log :

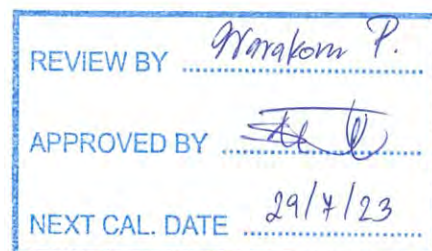
| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|--|---|
| October 21, 2021 9:38:57 AM | Audit | Data | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_B 2021-10-20 17-13-45\INJPREC_B006.D\FID2B.ch |
| October 21, 2021 9:38:57 AM | Audit | Data | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_B 2021-10-20 17-13-45\INJPREC_B007.D\FID2B.ch |
| October 21, 2021 9:39:06 AM | End | Execution | Injection Precision - Injection Tower, Back SSL, Back FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Run Count : 1 |
| October 21, 2021 9:39:11 AM | Start | Execution | Signal to Noise - Injection Tower, Back SSL, Back FID: - Detector FID - L: >= 300000 | None |
| October 21, 2021 9:39:28 AM | Audit | Data | Signal to Noise - Injection Tower, Back SSL, Back FID: - Detector FID - L: >= 300000 | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021_B 2021-10-20 17-13-45\SIGTONS_B001.D\FID2B.ch |
| October 21, 2021 9:39:39 AM | End | Execution | Signal to Noise - Injection Tower, Back SSL, Back FID: - Detector FID - L: >= 300000 | Run Count : 1 |
| October 21, 2021 9:39:43 AM | End | Qualification | Session | OQ |
| October 21, 2021 9:39:43 AM | Start | Reporting | Session | None |
| October 21, 2021 10:04:15 AM | Audit | Reporting | Session | Report Generated : Certificate |

CERTIFICATE OF CALIBRATION

Certificate No: WS-06012022

Page 1 of 2 pages

| | | | |
|-----------------------|--|--------|-----------------|
| Measurement Item | : Cup anemometer with data logger. | | |
| Manufacturer | : Data logger: Novalynx : Cup anemometer: Novalynx | | |
| Model/Type | : Data logger: 200-WS-25LB : Cup anemometer: WS-02F | | |
| Serial Number | : Data logger: A5191 : Cup anemometer: - | | |
| ID No | : Data logger: RYG_FS0328 : Cup anemometer: - | | |
| Customer | : ALS laboratory group (Thailand) co., ltd. : 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand. | | |
| Test Conditions | : Wind tunnel cross test section area | 900 | cm ² |
| | : Anemometer frontal area | 100 | cm ² |
| | : Diameter of mounting pipe | - | mm |
| | : Blockage ratio of test object | 0.111 | [-] |
| Test Conditions | : Air temperature | 23.9 | ±0.8 °C |
| | : Air pressure | 1014.8 | ±0.4 hPa |
| | : Relative air humidity | 58.9 | ±3.5 %RH |
| Calibration Procedure | Calibration was carried out base on; IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines; M&SNET Anemometer Calibration Procedure – Version 2: 2009; | | |
| Traceability | This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). | | |
| Measurement Date | : JAN 28, 2022. | | |
| Issued Date | : JAN 31, 2022. | | |



Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:


Mr. Parinya Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No.: WD-06012022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5191
: Wind direction sensor: -

ID No : Data logger: RYG_FS0328
: Wind direction sensor: -

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 $(23\pm3) ^\circ\text{C}$, and relative humidity of $(40\pm10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control, The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : JAN 26, 2022.

Issued Date : JAN 31, 2022.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-06012022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

| NO | Turning Direction | Nominal Angle (°) | Standard Reading (°) | UUC* Reading (°) | Error (°) | Uncertainty ±(°) |
|----|-------------------|----------------------|-------------------------|---------------------|--------------|---------------------|
| 1 | Clockwise | 0/360 | 0 | 1 | 1 | 3.0 |
| 2 | | 45 | 45 | 45 | 0 | 3.0 |
| 3 | | 90 | 90 | 91 | 1 | 3.0 |
| 4 | | 135 | 135 | 134 | -1 | 3.0 |
| 5 | | 180 | 180 | 179 | -1 | 3.0 |
| 6 | | 225 | 225 | 225 | 0 | 3.0 |
| 7 | | 270 | 270 | 272 | 2 | 3.0 |
| 8 | | 315 | 315 | 319 | 4 | 3.0 |
| 9 | Counter Clockwise | 0/360 | 0 | 1 | 1 | 3.0 |
| 10 | | 45 | 45 | 45 | 0 | 3.0 |
| 11 | | 90 | 90 | 91 | 1 | 3.0 |
| 12 | | 135 | 135 | 134 | -1 | 3.0 |
| 13 | | 180 | 180 | 179 | -1 | 3.0 |
| 14 | | 225 | 225 | 225 | 0 | 3.0 |
| 15 | | 270 | 270 | 272 | 2 | 3.0 |
| 16 | | 315 | 315 | 319 | 4 | 3.0 |

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 of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-05012022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 200-WS-25LB
: Cup anemometer: WS-02F

Serial Number : Data logger: A5190
: Cup anemometer: -

ID No : Data logger: RYG_FS0329
: Cup anemometer: -

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

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 23.6 ±0.8 °C
: Air pressure 1014.5 ±0.4 hPa
: Relative air humidity 53.4 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MCASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability : This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : JAN 28, 2022.

Issued Date : JAN 31, 2022.



Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

25ms
Mr. Parinya Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No.: WD-05012022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5190
: Wind direction sensor: -

ID No : Data logger: RYG_FS0329
: Wind direction sensor: -

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 (23 ± 3) °C, and relative humidity of (40 ± 10) %.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : JAN 26, 2022.

Issued Date : JAN 31, 2022.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....



Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-05012022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

| NO | Turning Direction | Nominal Angle (°) | Standard Reading (°) | UUC* Reading (°) | Error (°) | Uncertainty ±(°) |
|----|-------------------|----------------------|-------------------------|---------------------|--------------|---------------------|
| 1 | Clockwise | 0/360 | 0 | 0 | 0 | 3.0 |
| 2 | | 45 | 45 | 43 | -2 | 3.0 |
| 3 | | 90 | 90 | 90 | 0 | 3.0 |
| 4 | | 135 | 135 | 135 | 0 | 3.0 |
| 5 | | 180 | 180 | 181 | 1 | 3.0 |
| 6 | | 225 | 225 | 227 | 2 | 3.0 |
| 7 | | 270 | 270 | 273 | 3 | 3.0 |
| 8 | | 315 | 315 | 318 | 3 | 3.0 |
| 9 | Counter Clockwise | 0/360 | 0 | 0 | 0 | 3.0 |
| 10 | | 45 | 45 | 43 | -2 | 3.0 |
| 11 | | 90 | 90 | 90 | 0 | 3.0 |
| 12 | | 135 | 135 | 135 | 0 | 3.0 |
| 13 | | 180 | 180 | 181 | 1 | 3.0 |
| 14 | | 225 | 225 | 227 | 2 | 3.0 |
| 15 | | 270 | 270 | 273 | 3 | 3.0 |
| 16 | | 315 | 315 | 318 | 3 | 3.0 |

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 of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-03032022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 200-WS-25LB
: Cup anemometer: WS-02F

Serial Number : Data logger: A4917
: Cup anemometer: -

ID No : Data logger: BKK_FS0163
: Cup anemometer: -

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

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 25.8 ±0.8 °C
: Air pressure 1010.5 ±0.4 hPa
: Relative air humidity 41.9 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind
Turbines;
MEASNET Anemometer Calibration Procedure – Version 2: 2009;


Traceability : This calibration documents the traceable to national standard, Which realize the unit of
measurements according to the international system of units (SI) through National Institute of
Metrology Thailand (NIMT).

Measurement Date : MAR 17, 2022.

Issued Date : MAR 21, 2022.

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: 
Mr. Parinya Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No.: WD-03032022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB
: Wind direction sensor: WS-02P

Serial Number : Data logger: A4917
: Wind direction sensor: -

ID No : Data logger: BKK_FSO163
: Wind direction sensor: -

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 $(23 \pm 3) ^\circ\text{C}$, and relative humidity of $(40 \pm 10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control, The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : MAR 17, 2022.

Issued Date : MAR 21, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-03032022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

| NO | Turning Direction | Nominal Angle (°) | Standard Reading (°) | UUC* Reading (°) | Error (°) | Uncertainty ±(°) |
|----|-------------------|----------------------|-------------------------|---------------------|--------------|---------------------|
| 1 | Clockwise | 0/360 | 360 | 359 | -1 | 3.0 |
| 2 | | 45 | 45 | 43 | -2 | 3.0 |
| 3 | | 90 | 90 | 87 | -3 | 3.0 |
| 4 | | 135 | 135 | 132 | -3 | 3.0 |
| 5 | | 180 | 180 | 180 | 0 | 3.0 |
| 6 | | 225 | 225 | 229 | 4 | 3.0 |
| 7 | | 270 | 270 | 275 | 5 | 3.0 |
| 8 | | 315 | 315 | 320 | 5 | 3.0 |
| 9 | Counter Clockwise | 0/360 | 360 | 359 | -1 | 3.0 |
| 10 | | 45 | 45 | 43 | -2 | 3.0 |
| 11 | | 90 | 90 | 87 | -3 | 3.0 |
| 12 | | 135 | 135 | 132 | -3 | 3.0 |
| 13 | | 180 | 180 | 180 | 0 | 3.0 |
| 14 | | 225 | 225 | 229 | 4 | 3.0 |
| 15 | | 270 | 270 | 275 | 5 | 3.0 |
| 16 | | 315 | 315 | 320 | 5 | 3.0 |

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 of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-14072021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 200-WS-25LB.
: Cup anemometer: WS-02F.

Serial Number : Data logger: A5376.
: Cup anemometer: -.

ID No : Data logger: RYG_FS0414.
: Cup anemometer: -.

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

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 25.2 ±0.8 °C
: Air pressure 1006.6 ±0.4 hPa
: Relative air humidity 51.4 ±3.5 %RH

Calibration Procedure Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MCASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jul 29, 2021.

Issued Date : Jul 29, 2021.



Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: *[Signature]*

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

CERTIFICATE OF CALIBRATION

Certificate No.: WD-14072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB.
: Wind direction sensor: WS-02P.

Serial Number : Data logger: A5376.
: Wind direction sensor: -.

ID No : Data logger: RYG_FSO414.
: Wind direction sensor: -.

Customer : ALS laboratory group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10260
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3)^{\circ}\text{C}$, and relative humidity of $(40 \pm 10)\%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045, Certificate No.: KWS63/0044.

Measurement Date : Jul 29, 2021.

Issued Date : Jul 29, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-14072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

| NO | Turning Direction | Nominal Angle (°) | Standard Reading (°) | UUC* Reading (°) | Error (°) | Uncertainty ±(°) |
|----|-------------------|----------------------|-------------------------|---------------------|--------------|---------------------|
| 1 | Clockwise | 0/360 | 360 | 359 | -1 | 3.0 |
| 2 | | 45 | 45 | 43 | -2 | 3.0 |
| 3 | | 90 | 90 | 87 | -3 | 3.0 |
| 4 | | 135 | 135 | 132 | -3 | 3.0 |
| 5 | | 180 | 180 | 179 | -1 | 3.0 |
| 6 | | 225 | 225 | 228 | 3 | 3.0 |
| 7 | | 270 | 270 | 273 | 3 | 3.0 |
| 8 | | 315 | 315 | 318 | 3 | 3.0 |
| 9 | Counter Clockwise | 0/360 | 360 | 359 | -1 | 3.0 |
| 10 | | 45 | 45 | 43 | -2 | 3.0 |
| 11 | | 90 | 90 | 87 | -3 | 3.0 |
| 12 | | 135 | 135 | 132 | -3 | 3.0 |
| 13 | | 180 | 180 | 179 | -1 | 3.0 |
| 14 | | 225 | 225 | 228 | 3 | 3.0 |
| 15 | | 270 | 270 | 273 | 3 | 3.0 |
| 16 | | 315 | 315 | 318 | 3 | 3.0 |

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 of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-01092021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Cup anemometer: WS-02F

Serial Number : Data logger: A5662
: Cup anemometer: WSD-015

ID No : Data logger: -. F16J.5911/1
: Cup anemometer: -.

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

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 23.0 ±0.8 °C
: Air pressure 1012.8 ±0.4 hPa
: Relative air humidity 50.4 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MEASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability : This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Sep 14, 2021.

Issued Date : Sep 15, 2021.

REVIEW BY *Manakorn P.*

APPROVED BY *Wiporn*

NEXT CAL. DATE *15/3/23*

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: *Leempho*

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

CERTIFICATE OF CALIBRATION

Certificate No.: WD-01092021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Wind direction sensor: WS-02F.

Serial Number : Data logger: A5662
: Wind direction sensor: WSD-015.

ID No : Data logger: -
: Wind direction sensor: -

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 $(23\pm3)^{\circ}\text{C}$, and relative humidity of $(40\pm10)\%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control, The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045, Certificate No.: KWS63/0044.

Measurement Date : Sep 15, 2021.

Issued Date : Sep 15, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory.....

Handwritten signature

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-01092021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

| NO | Turning Direction | Nominal Angle (°) | Standard Reading (°) | UUC* Reading (°) | Error (°) | Uncertainty ±(°) |
|----|-------------------|----------------------|-------------------------|---------------------|--------------|---------------------|
| 1 | Clockwise | 0/360 | 0 | 0 | 0 | 3.0 |
| 2 | | 45 | 45 | 42 | -3 | 3.0 |
| 3 | | 90 | 90 | 88 | -2 | 3.0 |
| 4 | | 135 | 135 | 134 | -1 | 3.0 |
| 5 | | 180 | 180 | 181 | 1 | 3.0 |
| 6 | | 225 | 225 | 226 | 1 | 3.0 |
| 7 | | 270 | 270 | 273 | 3 | 3.0 |
| 8 | | 315 | 315 | 318 | 3 | 3.0 |
| 9 | Counter Clockwise | 0/360 | 0 | 0 | 0 | 3.0 |
| 10 | | 45 | 45 | 42 | -3 | 3.0 |
| 11 | | 90 | 90 | 88 | -2 | 3.0 |
| 12 | | 135 | 135 | 134 | -1 | 3.0 |
| 13 | | 180 | 180 | 181 | 1 | 3.0 |
| 14 | | 225 | 225 | 226 | 1 | 3.0 |
| 15 | | 270 | 270 | 273 | 3 | 3.0 |
| 16 | | 315 | 315 | 318 | 3 | 3.0 |

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 of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CL-067-64
Page 1 of 2

Equipment Name : Data Logger with Temperature
Sensor

Manufacturer : Novalynx
Model : 110-WS-25 DL-D
Serial No. : A5662
ID No. : -

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 : 1 SEP 2021
Calibration date : 13 SEP 2021
Issue date : 15 SEP 2021

Reference Used During Calibration

- 1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022
- 2.Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

Temperature : $(23 \pm 3)^{\circ}\text{C}$
Relative Humidity : $(55 \pm 15)\%$

Calibration Procedure

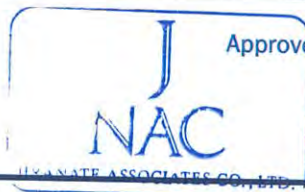
The temperature calibration was done by In-House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiwatwittaya



Approved Signatory:

JSmpas
Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Certificate No. : CL-067-64
Page 2 of 2

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : T2320591

Dimension : Diameter 12mm. Length 80 mm.

| <u>Immersion Depth (mm)</u> | <u>Standard Reading (°C)</u> | <u>UUC Reading (°C)</u> | <u>Error (°C)</u> | <u>Uncertainty (°C)</u> |
|-------------------------------------|--------------------------------------|---------------------------------|-----------------------|-----------------------------|
| 60 | 20.049 | 19.8 | -0.2 | 0.080 |
| 60 | 24.879 | 24.5 | -0.4 | 0.16 |
| 60 | 29.864 | 29.4 | -0.5 | 0.080 |
| 60 | 34.847 | 34.4 | -0.5 | 0.13 |
| 60 | 39.835 | 39.3 | -0.5 | 0.080 |

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 *



CALIBRATION REPORT

Calibration No. : RH-01092021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

Manufacturer : Data logger: Novalynx.
: Relative humidity sensor: Novalynx.

Model/Type : Data logger: 110-WS-25 DL-D.
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5662.
: Relative humidity sensor: T2320691.

ID No : Data logger: -
: Relative humidity sensor: -.

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 $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : Sep 13, 2021

Issued Date : Sep 15, 2021

Measurement Results:

The results of calibration are reported in table below.

| Standard salt solution. | Standard (%RH) | UUC _(Reading) | Error |
|--|----------------|--------------------------|-------|
| CH_3COOK : Potassium Acetate | 22.51 | 23.5 | 1.0 |
| $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate | 52.89 | 53.1 | 0.2 |
| KCl : Potassium Chloride | 84.34 | 83.9 | -0.4 |

Performed by

- ☐ Mr. Sorawit Thachalad
☒ Miss Orathai Wiatwittaya



Signatory: _____

Mr. Parinya Booncharoen.
Technical Support
And Calibration Manager

SITHIPHORN ASSOCIATES CO.,LTD.

CALIBRATION LABORATORY

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



Cert. No. : ACC22001

Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: - RY60496

Condition As Found : GOOD

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

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

Received Date : 05 JANUARY 2022
Calibration Date : 10 JANUARY 2022
Date of Issue : 13 JANUARY 2022

| | |
|----------------|--------------|
| REVIEW BY | Nathakorn P. |
| APPROVED BY | [Signature] |
| NEXT CAL. DATE | 10/1/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACC22001

Job No. : VC65AC0040

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 :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------|--------------|-------------------|------------------|-----------------|
| Waveform Generator | 33511B | MY52302742 | EF-0011-21 | 10-Feb-22 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 05/0264 | 10-Feb-22 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0264 | 08-Feb-22 |
| Digital Multimeter | 33461A | MY60024273 | 1-15180725251-1 | 15-Sep-22 |
| Programmable Attenuator | MAT-1070 | 62100114 | 1500-07774E | 08-Mar-22 |
| Condenser Microphone | 4180 | 2977900 | AA-1008-21 | 05-Feb-22 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3003-21 | 16-Feb-22 |
| Audio Analyzer | AVR-3360A | V744B6069 | EF-0010-21 | 10-Feb-22 |

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).

Continuation of Calibration Certificate

Cert. No. : ACC22001

Job No. : VC65AC0040

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 | 93.99 | -0.01 | 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 (%) |
|----------------------|-------------------|-----------------------|
| 0.28 | 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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22058

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296518 / 179118 / 87525
ID No.: RYG_FS0431

Condition As Found : GOOD

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

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

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 2022

| | |
|----------------|--------------------|
| REVIEW BY | <i>Narakorn P.</i> |
| APPROVED BY | <i>[Signature]</i> |
| NEXT CAL. DATE | 21/1/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22058

Job No. : VC65AC0043

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.96) | 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 | 17.6 |
| Flat | 23.2 |

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 | 0.1 | 0.1 | 0.1 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | 0.8 | 0.9 | 0.9 | ±5.0 |

Continuation of Calibration Certificate

Cert. No. : ACL22058
Job No. : VC65AC0043
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 | 98.9 | -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 | 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 |

Continuation of Calibration Certificate

Cert. No. : ACL22058

Job No. : VC65AC0043

Pages : 8 of 8

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------------------|----------------------------|-----------------------------|--------------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.7 | 89.7 | 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** _____

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22057

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296517 / 179120 / 87527
ID No.: RYG_FS0434

Condition As Found : GOOD

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

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

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 2022

| | |
|----------------|--------------------|
| REVIEW BY | <i>Narakorn P.</i> |
| APPROVED BY | <i>[Signature]</i> |
| NEXT CAL. DATE | 21/1/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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Continuation of Calibration Certificate

 Cert. No. : ACL22057
 Job No. : VC65AC0043
 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 |

Continuation of Calibration Certificate

Cert. No. : ACL22057

Job No. : VC65AC0043

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 | 89.6 | 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** —————

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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Cert. No. : ACL22193

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597167 / 157778 / 34375
ID No.: RYG_FS0437

Condition As Found : GOOD

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

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

Received Date : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

| | |
|----------------|-------------|
| REVIEW BY | Narakorn P. |
| APPROVED BY | [Signature] |
| NEXT CAL. DATE | 4/9/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22193

Job No. : VC65AC0081

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 :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------|--------------|-------------------|------------------|-----------------|
| 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).

Continuation of Calibration Certificate

Cert. No. : ACL22193

Job No. : VC65AC0081

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 |

Continuation of Calibration Certificate

Cert. No. : ACL22193

Job No. : VC65AC0081

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) |
|--------------------------|
| 18.3 |

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

| Frequency Weighting | Measured value (dB) |
|------------------------|--------------------------|
| A - weight | 15.1 |
| C - weight | 21.4 |
| Flat | 27.0 |

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 | 0.3 | 0.4 | 0.3 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | -0.6 | -0.6 | -0.6 | ±5.0 |

Continuation of Calibration Certificate

Cert. No. : ACL22193

Job No. : VC65AC0081

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 | 89.6 | 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

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22056

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296516 / 180412 / 88182
ID No.: RYG_FS0433

Condition As Found : GOOD

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

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

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 2022

| | |
|----------------|---------------------|
| REVIEW BY | <i>Nathakorn P.</i> |
| APPROVED BY | <i>[Signature]</i> |
| NEXT CAL. DATE | 21/1/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(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.

Continuation of Calibration Certificate

Cert. No. : ACL22056
Job No. : VC65AC0043
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 |

Continuation of Calibration Certificate

Cert. No. : ACL22056

Job No. : VC65AC0043

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.96) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|--------------------------|
| 14.8 |

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 | 17.7 |
| 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) | | | Acceptance Limits |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | |
| 125 | 0.1 | 0.1 | 0.1 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | 0.7 | 0.7 | 0.7 | ±5.0 |

Continuation of Calibration Certificate

Cert. No. : ACL22056
Job No. : VC65AC0043
Pages : 8 of 8

11. Overload indication

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

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACC22013

Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178121
ID No.: RYG_FS0213

Condition As Found : GOOD

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

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

Received Date : 22 APRIL 2022
Calibration Date : 26 APRIL 2022
Date of Issue : 29 APRIL 2022

| | |
|----------------|---------------------|
| REVIEW BY | <i>Nathakorn P.</i> |
| APPROVED BY | <i>[Signature]</i> |
| NEXT CAL. DATE | 26/4/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACC22013

Job No. : VC65AC0054

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 :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------|--------------|-------------------|------------------|-----------------|
| 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).

Continuation of Calibration Certificate

Cert. No. : ACC22013

Job No. : VC65AC0054

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 | 94.11 | 0.11 | 0.14 | 0.40 |

2. Frequency

| Specified Frequency (Hz) | Measured value (Hz) | Deviated value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------------------|---------------------------|--------------------------|--------------------|---------------------------|
| 1000 | 1003.1 | 0.3 | 0.1 | 1.0 |

3. Total distortion

| Measured value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------|-----------------|---------------------|
| 2.02 | 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 —————

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22023

Pages : 1 of 9

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21
Serial No.: 01133046 / 157226 / 09873
ID No.: RYG_FS0006

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 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 05 JANUARY 2022
Calibration Date : 10-12 JANUARY 2022
Date of Issue : 13 JANUARY 2022

| | |
|----------------|---------------------|
| REVIEW BY | <i>Nathakorn P.</i> |
| APPROVED BY | <i>[Signature]</i> |
| NEXT CAL. DATE | 10/1/23 |

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

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Continuation of Calibration Certificate

Cert. No. : ACL22023
Job No. : VC65AC0040
Pages : 2 of 9

Calibration Procedure : CP-AC-02

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 :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------|--------------|-------------------|------------------|-----------------|
| Waveform Generator | 33210A | MY48017076 | EF-0012-21 | 10-Feb-22 |
| Waveform Generator | 33511B | MY52302742 | EF-0011-21 | 10-Feb-22 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 05/0264 | 10-Feb-22 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0264 | 08-Feb-22 |
| Digital Multimeter | 8846A | 1997025 | EEL.BP. 06/0264 | 05-Feb-22 |
| Programmable Attenuator | MAT-1070 | 62100114 | 1500-07774E | 08-Mar-22 |
| Condenser Microphone | 4180 | 2977900 | AA-1008-21 | 05-Feb-22 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3003-21 | 16-Feb-22 |

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).

Continuation of Calibration Certificate

Cert. No. : ACL22023

Job No. : VC65AC0040

Pages : 3 of 9

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 |

Continuation of Calibration Certificate

Cert. No. : ACL22023
Job No. : VC65AC0040
Pages : 4 of 9

Result of calibration :**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.96) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|--------------------------|
| 21.9 |

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

| Frequency Weighting | Measured value (dB) |
|------------------------|--------------------------|
| A - weight | 21.4 |
| C - weight | 22.1 |
| Flat | 24.5 |

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) | | | Acceptance Limits |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | |
| 125 | 1.3 | 1.3 | 1.4 | ± 1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 8000 | -3.5 | -3.4 | -3.4 | ±5.0 |

Continuation of Calibration Certificate

Cert. No. : ACL22023

Job No. : VC65AC0040

Pages : 8 of 9

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, Lcpeak (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 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------------------|----------------------------|-----------------------------|--------------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.4 | 89.1 | -0.3 | ±1.5 |

Continuation of Calibration Certificate

Cert. No. : ACL22023

Job No. : VC65AC0040

Pages : 9 of 9

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

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 07 October 2022 CERTIFICATE NUMBER 181216

REVIEW BY

Markon P.

APPROVED BY

Nigel Smith

NEXT CAL. DATE

7/10/23

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Test engineer:

Nigel Smith

Electronically signed:

Nigel Smith

doseBadge Reader

Instrument

Manufacturer: Cirrus Research plc
Model Number: RC:110A

Serial Number: 92612
Notes:

Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: 07 October 2022

Functionality Results

| Function | Result |
|---------------|--------|
| Keypad | Pass |
| Battery Power | Pass |
| Display | Pass |
| Communication | Pass |
| 2 way IR link | Pass |
| Clock | Pass |

Calibration Results

| | Level (dB) | Frequency (Hz) | Distortion (% THD + Noise) |
|-------------|------------|----------------|----------------------------|
| Result | 113.99 | 1004.5 | 0.47 |
| Uncertainty | ± 0.11 | ± 0.14 | ± 0.10 |
| Tolerances | ± 0.60 | ± 2.00 | ± 4.00 |

No adjustments were made during this calibration.

Environmental Conditions

Pressure: 100.27 kPa
Temperature: 23.6 °C
Humidity: 45.3 %

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 03 November 2022 CERTIFICATE NUMBER 182475

REVIEW BY

Marlene P.

APPROVED BY

[Signature]

NEXT CAL. DATE

1/11/23

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Test engineer:

Nigel Smith

Electronically signed:

[Signature]

doseBadge Reader

Instrument

Manufacturer: Cirrus Research plc
Model Number: RC:110A

Serial Number: 75996
Notes:

Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: 01 November 2022

Functionality Results

| Function | Result |
|---------------|--------|
| Keypad | Pass |
| Battery Power | Pass |
| Display | Pass |
| Communication | Pass |
| 2 way IR link | Pass |
| Clock | Pass |

Calibration Results

| | Level (dB) | Frequency (Hz) | Distortion (% THD + Noise) |
|-------------|------------|----------------|----------------------------|
| Initial | 114.25 | 1004.0 | 0.26 |
| Adjusted | 114.00 | 1004.0 | 0.26 |
| Uncertainty | ± 0.11 | ± 0.14 | ± 0.10 |
| Tolerances | ± 0.60 | ± 2.00 | ± 4.00 |

Environmental Conditions

Pressure: 99.05 kPa
Temperature: 22.1 °C
Humidity: 48.6 %

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **07 October 2022** CERTIFICATE NUMBER **181219**

REVIEW BY *Morahan P.*
 APPROVED BY *Nigel Smith*
 NEXT CAL. DATE **7/10/23**



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1

Test engineer:
Nigel Smith
 Electronically signed:

Nigel Smith

doseBadge Reader

Instrument

Manufacturer: **Cirrus Research plc**
 Model Number: **RC:110A**

Serial Number: **76062**
 Notes:

Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: **07 October 2022**

Functionality Results

| Function | Result |
|---------------|--------|
| Keypad | Pass |
| Battery Power | Pass |
| Display | Pass |
| Communication | Pass |
| 2 way IR link | Pass |
| Clock | Pass |

Calibration Results

| | Level (dB) | Frequency (Hz) | Distortion (% THD + Noise) |
|-------------|------------|----------------|----------------------------|
| Initial | 113.66 | 1009.5 | 0.36 |
| Adjusted | 113.99 | 1009.5 | 0.41 |
| Uncertainty | ± 0.11 | ± 0.14 | ± 0.10 |
| Tolerances | ± 0.60 | ± 2.00 | ± 4.00 |

Environmental Conditions

Pressure: **100.27 kPa**
 Temperature: **23.8 °C**
 Humidity: **45.9 %**

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.



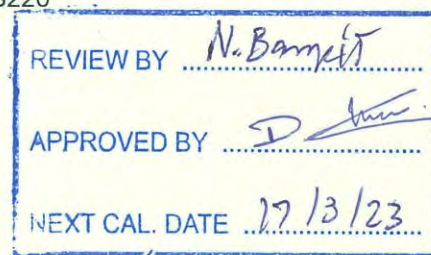
TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH405
Page.: 1 of 3

Certificate of Calibration

| | |
|-------------------------|---|
| Equipment : | pH Meter |
| Manufacturer : | Mettler Toledo |
| Model : | Seven Compact S220 |
| Serial No. : | C104059460 |
| ID No. : | RYG_EN0183 |
| Condition As-Received: | Used Item |
| Received Date : | 16 March 2022 |
| Calibration Date : | 17 March 2022 |
| Reference : | 2203-0611DSC-4 |
| 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 Lernagtrakul

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
() Saithip Meangmai
() Warakorn Lernagtrakul

Issue Date : 22 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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.

A 0037307



Cert.No.: 22CH405

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

| <u>Instrument</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 54030049 | 130RC116 | 21E2682 | 25 Aug 2022 |
| 2) Ref. Standard Thermometer | 4982054 | 110RC044 | 21I1201 | 26 Oct 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

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 4.008 | CPA chem | 788995 | 01 Jan 2024 |
| pH 6.982 | CPA chem | 761017 | 02 Aug 2022 |
| pH 10.015 | CPA chem | 766824 | 04 Sep 2022 |

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 <i>k</i> |
|------------------------------|---------------|------------------------|----------------|--------|---------------------------------------|-----------------------------|
| | pH | mV | mV | pH | | |
| pH Meter S/N.: C104059460 | 4.000 | 177.48 | 177.4 | 4.000 | 0.058 | 2.00 |
| | 7.000 | 0.00 | -0.1 | 7.000 | 0.058 | 2.00 |
| | 10.000 | -177.48 | -177.5 | 10.000 | 0.058 | 2.00 |

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Cert.No.: 22CH405

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.: 1453404 | 4.008 | 4.010 | 177.7 | 0.0046 | 2.00 |
| | 6.982 | 6.988 | 3.6 | 0.0084 | 2.00 |
| | 10.015 | 10.010 | -172.9 | 0.0073 | 2.05 |

Function : Temperature Measurement**(*) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM

- Serial No. : 1453404

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

| Calibration Point ($^{\circ}\text{C}$) | Standard Temperature ($^{\circ}\text{C}$) | UUC* Reading ($^{\circ}\text{C}$) | Error ($^{\circ}\text{C}$) | Uncertainty of measurement (\pm $^{\circ}\text{C}$) | Coverage factor k |
|--|---|-------------------------------------|------------------------------|---|---------------------|
| 25.0 | 25.002 | 24.9 | -0.102 | 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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Maku.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 22E986

Page : 1 of 2

Equipment : pH Meter
Manufacturer: Mettler Toledo
Model : SevenCompact S220
Serial No.: C104059460
ID No.: RYG_EN0183

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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: 16 March 2022

Calibration Date: 21 March 2022

Reference: 2203-0611DSC

Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 10) %

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 :

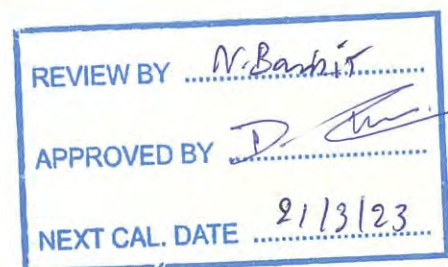
| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Multi-Product Calibrator | 5500A | 6440007 | 21E1444 | 07 May 2022 |

2.This result of calibration was made on requested at the point specified by customer.

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

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

-National Institute of Metrology Thailand (NIMT)



Calibrated by : Pongsagorn Boonyaporn
Issue Date : 22 March 2022

Approved Signatory :

☒ Phalinee Prabpaipal

☐ Nuntawat Khamchai

☐ Pornthippa Tameyakul

B 0284414



Cert. No.: 22E986

Page.: 2 of 2

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

| Function: | DC voltage measurement | Range: | 2000 | mV |
|-----------|------------------------|---------------------|--------------|--------------------|
| | <u>Standard Value</u> | <u>UUC* Reading</u> | <u>Error</u> | <u>Uncertainty</u> |
| | (mV) | (mV) | (mV) | ($\pm \mu V$) |
| | -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 | 200.0 | 0.0 | 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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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 : | 2202-0404DSC-4 |
| Submitted by : | ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand |
| Laboratory Condition : | Temperature (25 ± 5) °C Humidity (50 ± 20) % |
| Test Procedure : | In - house method : CP-CH9 by Comparison Technique with Azide Modification Method |
| Tested by : | Walalak Sirithean |
| Approved by : |  Approved Signatory |
| () Malee Butkruea | |
| (<input checked="" type="checkbox"/>) Saithip Meangmai | |
| () Warakorn Lerngagtrakul | |
| Issue Date : | 18 February 2022 |

| | |
|----------------|-----------|
| REVIEW BY | N. Bannij |
| APPROVED BY | D. Chai |
| 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.: 15E100464

| 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 Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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Saithip



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Cert. No.: 22LM12

Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG_EN0032

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

Location : TPA On Site Calibration Laboratory

Received Order : 11 February 2022

Calibrated Date : 21 February 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Kunchit Promprat

Approved by : Malee Butkruea
Approved Signatory

() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date : 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0038008



Equipment : DO Meter with Sensor

Condition As-Received : Used Item

Reference : 2202-0404DSC-5

Cert. No.: 22LM12

Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 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:-

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|------------------------|--------------|-------------------|------------------|-----------------|
| 1) Digital Thermometer | 1523 | 2188080 | 2111273 | 22 Nov 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.: 15E100464

| <u>Calibration Point</u> (°C) | <u>Immersion Depth</u> (mm) | <u>Standard Temperature</u> (°C) | <u>UUC* Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty</u> (± °C) | <u>Coverage Factor</u> <i>k</i> |
|------------------------------------|----------------------------------|---------------------------------------|-------------------------------|------------------------|--------------------------------|------------------------------------|
| 20.00 | 45 | 20.001 | 19.88 | -0.121 | 0.15 | 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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Cert. No.: 22TM317

Page.: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator

Manufacturer : Memmert

Model : IPP750

Serial No. : V818.0084

ID No. : RYG_EN0154

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

Location : BOD Room

Received Order : 22 April 2022

Calibration Date : 22 April 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

| | |
|----------------|-----------------------|
| REVIEW BY | <i>N. Banvit</i> |
| APPROVED BY | <i>D. [Signature]</i> |
| NEXT CAL. DATE | 21/10/23 |

Approved by :

Manu

Approved Signatory

- () Pornthippa Tameyakul
(/) Malee Butkruea
() Suwit Imjai

Issue Date :

3 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0040735



Equipment : Low Temp. Incubator

Condition As-Received : Used Item

Reference : 2204-0146OC-1

Cert. No.: 22TM317

Page.: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement

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 | MY44031769 | 21LM12 | 02 Sep 2022 |

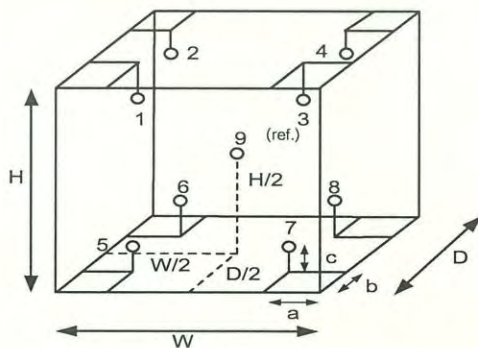
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



| Environment during calibration | | |
|--------------------------------|-----------|----------|
| | Beginning | Finished |
| Temp. (°C) | 25 | 25 |
| REL.Humid. (%) | 54 | 58 |
| AC Supply (Volt) | 221 | 223 |

Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.60 m
W = 1.0 m
H = 1.2 m
Capacity = 0.75 m³

| Position : | Ref. Std. ID No.: |
|------------|-------------------|
| 1 | 9RTD-2/1 |
| 2 | 9RTD-2/2 |
| 3 | 9RTD-2/3 |
| 4 | 9RTD-2/4 |
| 5 | 9RTD-2/5 |
| 6 | 9RTD-2/6 |
| 7 | 9RTD-2/7 |
| 8 | 9RTD-2/8 |
| 9 (ref.) | 9RTD-2/9 |

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Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2204-0146OC-1
Result of Calibration :- (*) Without Adjustment

Cert. No.: 22TM317

Page.: 3 of 3

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 <i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-------------------------|-----------------------------|
| 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 %.

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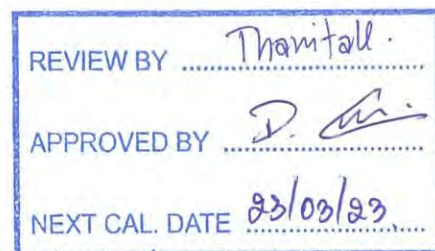


Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22103

| | | | |
|------------------|-----------------|------------|------------|
| Certificate No.: | PTC/07/22103 | Page: | 1 of 2 |
| Equipment: | Digital Balance | Condition: | Normal |
| Manufacturer: | Sartorius | Serial No: | 26207038 |
| Model: | MSE224S-100-DU | ID No: | RYG_EN0002 |
| Type of Balance: | Single interval | | |

Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,
Rayong 21140, Thailand



Environment Condition: Temperature 23.9 °C \pm 0.3 °C
Humidity 58.1 %RH \pm 4.4 %RH
Air density 1.17 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,
Rayong 21140, Thailand

The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO.,LTD.

Mr. Kriangsak Kalasri

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

Mr. Keattisak Kerdto

(Mr. Keattisak Kerdto)

Laboratory Manager

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 recognised national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., Ltd



Represent to Certificate of Calibration ,PTC/07/22103

Certificate No.: PTC/07/22103

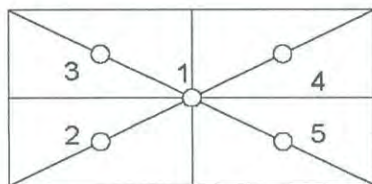
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 100 (g)

| Position (g) | | | | |
|--------------------|--------|---------|--------|--------|
| 1 | 2 | 3 | 4 | 5 |
| 0.0000 | 0.0000 | -0.0002 | 0.0002 | 0.0002 |
| Maximum deviation: | | | 0.0002 | |

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

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

| Nominal test value (g) | Standard Deviation |
|------------------------|--------------------|
| 20 | 0.000042 |
| 200 | 0.000027 |

Error of indication : from nominal value., Readability 0.0001 (g)

| Nominal Value (g) | Conventional Mass (g) | Indication (g) | Correction of Balance (g) | Uncertainty (g) | k |
|-------------------|-----------------------|----------------|---------------------------|-----------------|------|
| 0 | 0.00000 | 0.0000 | 0.0000 | 0.000086 | 2.16 |
| 0.01 | 0.01000 | 0.0100 | 0.0000 | 0.00010 | 2.06 |
| 0.1 | 0.10000 | 0.1000 | 0.0000 | 0.00010 | 2.06 |
| 1 | 1.00000 | 1.0000 | 0.0000 | 0.00010 | 2.06 |
| 2 | 2.00000 | 1.9999 | 0.0001 | 0.00010 | 2.06 |
| 5 | 5.00001 | 5.0000 | 0.0000 | 0.00010 | 2.06 |
| 10 | 10.00000 | 10.0000 | 0.0000 | 0.00010 | 2.06 |
| 20 | 20.00003 | 19.9999 | 0.0001 | 0.00011 | 2.05 |
| 50 | 50.00004 | 49.9999 | 0.0001 | 0.00012 | 2.00 |
| 100 | 100.00004 | 100.0001 | -0.0001 | 0.00017 | 2.00 |
| 200 | 200.00011 | 200.0000 | 0.0001 | 0.00027 | 2.00 |

Note: Weight of adjust - (g)

The End of Certificate



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



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 ± 10) °C |
| Relative Humidity : | (50 ± 30) % |
| Calibrated by : | Man Pattanapongpaiboon |

REVIEW BY Thanitall
APPROVED BY D. [Signature]
NEXT CAL. DATE 20/04/24

Approved by :

Malu

Approved Signatory

- () Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date :

2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



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

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

Procedure Used :-

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 | MY49023932 | 22LM97 | 29 Jul 2023 |

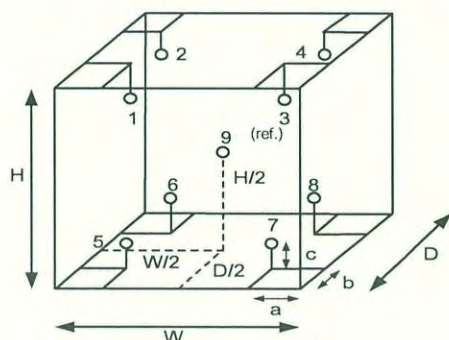
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



| 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 |

Probe Installation Details :

Dimension of Chamber :

| | | | | | |
|-----|-----|----|------------|------|----------------|
| a = | 5.0 | cm | D = | 0.40 | m |
| b = | 5.0 | cm | W = | 0.56 | m |
| c = | 5.0 | cm | H = | 0.48 | m |
| | | | Capacity = | 0.11 | m ³ |

Malu



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1517

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 <i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-------------------------|-----------------------------|
| 104.0 | 104.0 | 104.0 | 0.076 | 0.52 | 0.60 | 0.42 | 2 |
| 180.0 | 180.0 | 180.0 | 0.13 | 0.88 | 1.2 | 1.1 | 2 |

| Calibration Point (°C) | Measured Temperature (°C) | | | | | | | | |
|-----------------------------|-----------------------------|---------|---------|---------|---------|---------|---------|---------|----------|
| | Position | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 104.0 | 103.768 | 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 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 %.

-o0o-

Malu .



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM1492

Page : 1 of 3

Certificate of Calibration

| | |
|------------------------------|--|
| Equipment : | Hot Air Oven |
| Manufacturer : | Memmert |
| 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. Pluakdaeng, 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 : Preecha Hlahib

Approved by :

Malu.
Approved Signatory

- (☒) Pornthippa Tameyakul
(☒) Malee Butkruea
(☐) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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.



Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2210-0376OC-1

Cert. No.: 22TM1492
 Page : 2 of 3

Procedure Used :-

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.

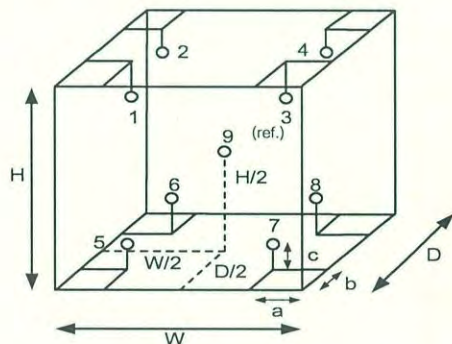
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

| 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 |

Probe Installation Details :

a = 5.0 cm
 b = 5.0 cm
 c = 5.0 cm

Dimension of Chamber :

D = 0.33 m
 W = 0.40 m
 H = 0.40 m
 Capacity = 0.053 m³

Malu



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-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 <i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-------------------------|-----------------------------|
| 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 | 70.688 | 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 %.

-o0o-

Malu.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



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 : | ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, 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 Hlahib |



Approved by :

Approved Signatory

- () Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date :

2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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.



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2210-0376OC-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:-

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|----------------------|--------------|-------------------|------------------|-----------------|
| 1) Data Acquisition | 34970A | MY44035217 | 21LM30 | 23 Dec 2022 |

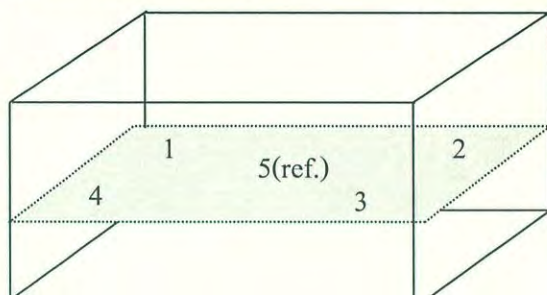
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

| | Environmental | | AC Voltage Supply |
|--------------------------|---------------|-----------|-------------------|
| | (°C) | (%R.H.) | (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 |

Malu



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2210-0376OC-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 <i>k</i> |
|--------------------------------|----------------------|-----------------------|-------------------------|--------------------------------|
| 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.

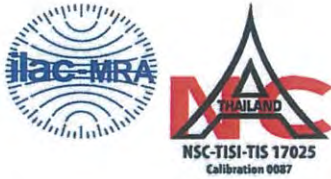
UUC* : Unit Under Calibration

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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Malu.



Certificate of Calibration

| | | | |
|-----------------------------|----------------------|-------------------------|-------------------|
| Equipment: | SPECTROPHOTOMETER | Certificate No.: | C06220464 |
| Model: | DR6000 | Issued Date: | 27 September 2022 |
| Serial No. (or ID.): | 1627845 (RYG_EN0037) | Job No.: | KSPR2212224 |
| Manufacturer: | HACH | Page: | 1 of 3 |
| Condition: | In Condition | | |

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

REVIEW BY N. Banet
APPROVED BY D. [Signature]
NEXT CAL. DATE 27/13/24

Environment Condition:

| | | | |
|-------------|------|-----|---|
| Temperature | 23.1 | °C | ± |
| 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. Chattuphon Foithong

Calibration Date: 27 September 2022

The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

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. 91418 and 91435
The standard for Photometric Certificate No. 91441 and 101088
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037


(Mr. Chattuphon Foithong)
Person in charge


(Mr. Thalerngkeat Pounngam)
Authorized signatory

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

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Calibration Results:
Without Adjustment

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

| Standard Wavelength | Unit Under Calibration | Correction | Uncertainty |
|---------------------|------------------------|------------|-------------|
| 418.61 | 418.4 | 0.21 | 0.14 |
| 536.66 | 536.7 | -0.04 | 0.14 |
| 637.98 | 638.3 | -0.32 | 0.14 |
| 748.48 | 748.8 | -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 |
| | 0.5024 | 0.506 | -0.0036 | 0.0045 |
| | 0.6693 | 0.672 | -0.0027 | 0.0045 |
| | 0.9604 | 0.964 | -0.0036 | 0.0045 |
| 546.1 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5168 | 0.519 | -0.0022 | 0.0045 |
| | 0.6903 | 0.691 | -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 | -0.0015 | 0.0045 |
| | 0.7175 | 0.718 | -0.0005 | 0.0045 |
| | 1.0301 | 1.031 | -0.0009 | 0.0045 |
| 635 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5367 | 0.538 | -0.0013 | 0.0045 |
| | 0.6847 | 0.685 | -0.0003 | 0.0046 |
| | 0.9823 | 0.983 | -0.0007 | 0.0045 |

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 |
| | 0.8609 | 0.861 | -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 (%T) | Absorbance (A) |
|--------------------|----------------------|------------------------|----------------|
| 260.67 +/- 0.11 nm | 260.7 | 2.1 | 1.678 |
| 391.94 +/- 0.11 nm | 391.9 | 1.7 | 1.770 |

Spectral Resolution *

| Nominal Concentration 0.02 % v/v | Peak | Trough | Ratio | SBW |
|----------------------------------|--------|--------|-------|------|
| Standard Wavelength (nm) | 268.60 | 266.63 | 1.39 | 2.00 |
| UUC: Wavelength (nm) | 268.2 | 266.1 | | |
| Std Absorbance (A) | 0.4810 | 0.3176 | | |
| Absorbance (A) | 0.373 | 0.268 | | |

* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR6000

หมายเลขเครื่อง: 1627845

| ตรวจสอบ (รับ) | | รายการตรวจเช็ค | 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-นอกเครื่อง) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. สวิตซ์ ปิด – เปิด เครื่อง (On-Off Swicth) | <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. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. ตัวหมุนเลือกความยาวคลื่น (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 ได้ 656.1 nm |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9. แหล่งกำเนิดแสง (UV < 3,000 hour) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 10. แหล่งกำเนิดแสง (Visible < 5,000 hour) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 11. ช่องวัดหลายตัวอย่าง (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. ฝาปิดกันปลาย Electrode (Dust Protection Hood) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 15. ขาจับอิเล็กโทรด (Stand) | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Turbidimeter | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 16. ค่าความขุ่นที่ต่ำสุด (No Sample) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0) | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Automatic titrator | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 18. สภาพ Piston Burettes | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 19. Function Rinsing and Dosing | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 20. ระบบท่อสายยางและอุปกรณ์ประกอบ | <input type="checkbox"/> | <input type="checkbox"/> | |

เพิ่มเติม/ข้อแนะนำ :

Mr. Chattuphon Foithong

Service Engineer



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH377

Page.: 1 of 2

Certificate of Calibration

| | |
|-------------------------|---|
| Equipment : | pH Meter |
| Manufacturer : | Mettler Toledo |
| Model : | Seven2Go |
| Serial No. : | B531256371 |
| ID No. : | RYG_FS0420 |
| Condition As-Received: | Used Item |
| Received Date : | 11 March 2022 |
| Calibration Date : | 14 March 2022 |
| Reference : | 2203-0495DSC-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) |



Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

- (✓) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0039308



Cert. No.: 22CH377

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

| <u>Instrument</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 54030049 | 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

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 4.008 | CPA chem | 766820 | 23 Sep 2023 |
| pH 6.983 | CPA chem | 766822 | 04 Sep 2022 |
| pH 10.015 | CPA chem | 766824 | 04 Sep 2022 |

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 <i>k</i> |
|------------------------------|---------------|------------------------|----------------|-------|---------------------------------------|-----------------------------|
| | pH | mV | mV | pH | | |
| pH Meter S/N.: B531256371 | 4.00 | 177.48 | 177 | 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 |

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 <i>k</i> |
|-------------------------------|-----------------------------|-------------------|-----------------------------|--|-----------------------------|
| pH Electrode S/N.: 1311407 | 4.008 | 4.01 | 181 | 0.0079 | 2.00 |
| | 6.983 | 6.98 | 7 | 0.0093 | 2.00 |
| | 10.015 | 10.01 | -171 | 0.0092 | 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 %.

-o0o-

maker



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22LM41

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor

Manufacturer : Mettler Toledo

Model : Seven2Go

Serial No. : B531256371

ID No. : RYG_FS0420

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 : 11 March 2022

Calibrated Date : 15 March 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Malee Butkruea

Approved by :

Approved Signatory

() Pornthippa Tameyakul
(✓) Suwit Imjai

Issue Date : 17 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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.

A 0039307



Equipment : pH Meter with Sensor

Cert. No.: 22LM41

Condition As-Received : Used Item

Page.: 2 of 2

Reference : 2203-0495DSC-2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 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:-

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|------------------------|--------------|-------------------|------------------|-----------------|
| 1) Digital Thermometer | 1523 | 2188080 | 2111273 | 22 Nov 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.: 1311407

| <u>Calibration Point</u> (°C) | <u>Immersion Depth</u> (mm) | <u>Standard Temperature</u> (°C) | <u>UUC* Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty</u> (± °C) | <u>Coverage Factor</u> <i>k</i> |
|------------------------------------|----------------------------------|---------------------------------------|-------------------------------|------------------------|--------------------------------|------------------------------------|
| 25.0 | 100 | 25.009 | 25.4 | 0.391 | 0.16 | 2.00 |
| 30.0 | 100 | 30.008 | 30.5 | 0.492 | 0.16 | 2.00 |
| 40.0 | 100 | 39.997 | 40.6 | 0.603 | 0.16 | 2.00 |
| 50.0 | 100 | 49.997 | 50.6 | 0.603 | 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 %.

-o0o-

Geni



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



Certificate No. T220384I01 "Substitute for Calibration Certificate Number T220384" Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold Room)

Manufacturer : MODULAR

Model : IREVCOHCOO

Serial No. : C00351459

Customer Code : RYG_EN0184


ID No. : T1939A5

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

Customer Location : Laboratory

Date of Receipt : 18 February 2022

Calibrated By : Boonchai Suriyawong (Site Calibration Manager)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 18 MAR 2022



The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T220384I01

Page 2 of 4

Calibration Report

Equipment : Chamber (Cold Room)
Date of Calibration : 22 February 2022
Environment : Temperature : 23.2-24.3 °C
Line Voltage : 221.8-227.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

| Instrument | Model | Instrument No. | Certificate No. | Due Date |
|-------------|--------|----------------|-----------------|---------------|
| TC | TYPE T | TN141-TN150 | T210743 | 21 April 2022 |
| TC | TYPE T | TN151-TN160 | T210743 | 21 April 2022 |
| DATA LOGGER | 34970A | T150 | T210743 | 21 April 2022 |

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant - Hour 40 Minute At 3 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment

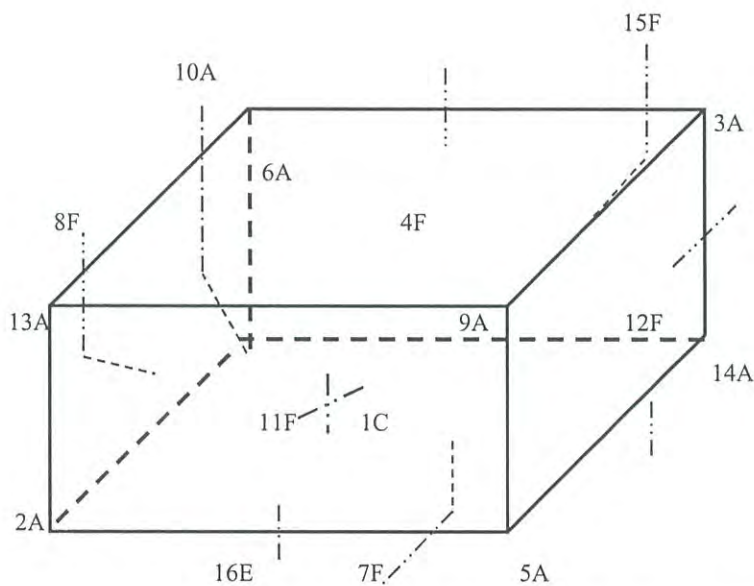
() after adjustment

Approved By. 

Certificate No. T220384I01

Page 3 of 4

Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

| | | |
|-----|---|-------|
| 1C | = | TN141 |
| 2A | = | TN142 |
| 3A | = | TN143 |
| 4F | = | TN144 |
| 5A | = | TN145 |
| 6A | = | TN146 |
| 7F | = | TN147 |
| 8F | = | TN148 |
| 9A | = | TN149 |
| 10A | = | TN150 |
| 11F | = | TN151 |

| | | |
|-----|---|-------|
| 12F | = | TN152 |
| 13A | = | TN153 |
| 14A | = | TN154 |
| 15F | = | TN155 |
| 16E | = | TN156 |

Approved By. 

Certificate No. T220384I01

Page 4 of 4

Calibration Report

Measurement Results

| Calibration Point | Average Standard Reading at each position (°C) | | | | | | | | | |
|-------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | TN141 | TN142 | TN143 | TN144 | TN145 | TN146 | TN147 | TN148 | TN149 | TN150 |
| 3.0 | 2.80 | 2.96 | 2.98 | 2.97 | 3.16 | 3.29 | 2.95 | 3.14 | 3.10 | 3.45 |
| | TN151 | TN152 | TN153 | TN154 | TN155 | TN156 | | | | |
| | 3.04 | 3.19 | 3.03 | 3.34 | 3.21 | 3.11 | | | | |

| Chamber (Cold Room) | | | Temperature Distribution | | | | |
|-----------------------|----------------|---------|--------------------------|--------------------|-------------------|----------------------|-----------------------------|
| Setting (°C) | Reading (°C) | | Average (°C) | Stability (± °C) | Uniformity (°C) | Uncertainty (± °C) | Coverage Factor <i>k</i> |
| | Min , Max | Average | | | | | |
| 3.0 | 2.7 , 4.1 | 3.5 | 3.11 | 1.30 | 1.30 | 2.00 | 2.05 |


* The Acuoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. _____



REVIEW BY

Nont Somb

APPROVED BY

KL AL

NEXT CAL. DATE

21/12/23

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-7
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Patthanakarn 40, Patthanakarn rd., Khwang Suan Luang, Khet Suan Luang, Bangkok 10250
Date: June 21, 2022 2:04:12 PM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.50, GCMS.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Setpoint Status: Pass

| | Setpoint | | Actual | |
|----------------------|----------|-----|--------|-----|
| Inlet Pressure: | 25.0 | psi | 25.0 | psi |
| Accuracy: | | | 0.0 | psi |
| Agilent Recommended: | | | <= 1.2 | |

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Date: June 21, 2022 2:04:12 PM
System ID: GM-7

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

230.0

230.0

°C

Accuracy:

0.0

°C

Agilent Recommended:

>=

-1.0

% setpoint in K

(

-5.0

°C

)

<=

1.0

% setpoint in K

(

5.0

°C

)

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

100.0

100.4

°C

Accuracy:

0.4

°C

Agilent Recommended:

>=

-1.0

% setpoint in K

(

-3.7

°C

)

<=

1.0

% setpoint in K

(

3.7

°C

)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:

7890

Setpoint Status:

Pass

Setpoint/Average

Temperature:

100.0

100.0333

°C

Stability:

0.1

°C

Agilent Recommended:

<=

0.5

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Setpoint Status:

Pass

Date:

June 21, 2022 2:04:12 PM

System ID:

GM-7

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Setpoint Status:

Pass

Amu:

1050

m/z

Drift After Five Minutes:

22

mV

RFPA Voltage:

568

mV

Agilent Recommended:

>=

-100

and

<=

100

<=

1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Setpoint Status:

Pass

Filament:

1

Setpoint Status:

Pass

Filament:

2

Overall Tune EI Test Status

Pass

Signal to Noise EI

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977A

Date:

June 21, 2022 2:04:12 PM

System ID:

GM-7

Source: Filament:

Setpoint Status:

Signal to Noise:

Agilent Recommended:

Source: Filament:

Setpoint Status:

Signal to Noise:

Agilent Recommended:

This test's 0 comment(s) and 1 deviation(s) are available in the Attachments section.

Overall Signal to Noise EI Test Status

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

| | |
|--------------|----------------------|
| System ID | GM-7 |
| Manufacturer | Agilent Technologies |
| Name | 7890 |

Tested Combination1

| | |
|---------------------|------------------|
| Injection Technique | Manual Injection |
| Inlet | Front |
| Detector | External |
| LTM Included? | No |

Sampler 1

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Manual Injection |
| Usage | Sample Injection |
| Syringe Volume (µL) | 10 |

Mainframe 1

| | |
|-------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Model Number | G3442B |
| Serial Number | CN14133181 |
| Firmware Revision | B.02.03 |
| Oven Type | Standard |

Inlet 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | SSL |
| Location | Front |
| Carrier Gas | Helium |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes |

Detector 1

| | |
|--------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name | Mass Spectrometer |
| Type | Mass Spectrometer |
| Location | External |

Mass Spectrometer 1

| | |
|-----------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | SQ |
| Name | 5977A |
| Serial Number | US1415M209 |
| Firmware Revision | 5977 6.00.21 |
| High Vacuum System | Turbo Pump |
| Scouting Run Standard | OFN Std |

MS EI Source 1

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Source Type | EI - Extractor |
| Number of filaments | 2 |

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

| | |
|--------------------------|---|
| Full Name of Signer: | Supasak Nimsongtham |
| Logged On User Name: | supasak.nimsongtham@agilent.com |
| Signature Creation Date: | June 21, 2022 |
| Reason for Signature: | Executed protocol and published this original version of document |

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User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| June 21, 2022 10:25:05 AM | Audit | SessionCreated | Session | None |
| June 21, 2022 10:25:05 AM | Start | Configuration | Session | None |
| June 21, 2022 10:25:05 AM | Audit | Entitlement | Licensing | User is FieldEngineer and does not require an unlock code |
| June 21, 2022 10:25:26 AM | Audit | EqpLoaded | Session | EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.50/Gc.02.50.eqp], EQP File Name: [Gc.02.50.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.50/GcMs.02.50.eqp], EQP File Name: [GcMs.02.50.eqp], EQP Name: [AgilentRecommended] |
| June 21, 2022 10:25:39 AM | End | Configuration | Session | None |
| June 21, 2022 10:25:43 AM | Start | Qualification | Session | OQ |
| June 21, 2022 10:25:43 AM | Start | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | None |
| June 21, 2022 10:25:54 AM | End | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | Run Count : 1 |

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|----------------------|
| June 21, 2022 10:26:00 AM | Start | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | None |
| June 21, 2022 10:26:10 AM | End | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | Run Count : 1 |
| June 21, 2022 10:26:12 AM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| June 21, 2022 10:34:09 AM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| June 21, 2022 10:34:10 AM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| June 21, 2022 10:34:11 AM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| June 21, 2022 10:38:42 AM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| June 21, 2022 10:38:44 AM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| June 21, 2022 10:38:46 AM | Start | Execution | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | None |

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Date: June 21, 2022 2:04:12 PM
 System ID: GM-7

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| June 21, 2022 11:01:00 AM | Audit | AceClosed | Session | None |
| June 21, 2022 11:01:47 AM | Audit | AceRestarted | Session | None |
| June 21, 2022 11:01:48 AM | Audit | SessionReloaded | Session | None |
| June 21, 2022 11:01:51 AM | Start | Qualification | Session | OQ |
| June 21, 2022 11:01:51 AM | Start | Execution | GC Oven Temperature Stability | None |
| | | | - 7890: - Temperature : Oven - | |
| | | | S: 100.0°C - L: <= 0.5°C | |
| June 21, 2022 11:03:14 AM | Audit | Data | DataManager | DataManager was in a data verification state but the user chose to start over. |
| June 21, 2022 11:04:19 AM | Audit | Data | GC Oven Temperature Stability | Manual Data Entry |
| | | | - 7890: - Temperature : Oven - | |
| | | | S: 100.0°C - L: <= 0.5°C | |
| June 21, 2022 11:04:22 AM | End | Execution | GC Oven Temperature Stability | Run Count : 1 |
| | | | - 7890: - Temperature : Oven - | |
| | | | S: 100.0°C - L: <= 0.5°C | |
| June 21, 2022 11:04:24 AM | Start | Execution | Log Amp - 5977A SQ: - Source: EI | None |
| | | | - Extractor | |
| June 21, 2022 11:04:34 AM | End | Execution | Log Amp - 5977A SQ: - Source: EI | Run Count : 1 |
| | | | - Extractor | |
| June 21, 2022 11:04:37 AM | Start | Execution | RFPA - 5977A SQ: - Source: EI | None |
| | | | - Extractor | |
| June 21, 2022 11:07:49 AM | End | Execution | RFPA - 5977A SQ: - Source: EI | Run Count : 1 |
| | | | - Extractor | |
| June 21, 2022 11:07:52 AM | Start | Execution | Tune EI - 5977A SQ: - Source: - | None |
| | | | EI - Extractor Filament 1 | |
| | | | (Qualitative - No setpoints associated) | |

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|----------------------|
| June 21, 2022 11:08:35 AM | End | Execution | Tune EI - 5977A SQ: - Source: - Run Count : 1 EI - Extractor Filament 1 (Qualitative - No setpoints associated) | |
| June 21, 2022 11:14:59 AM | Start | Execution | Tune EI - 5977A SQ: - Source: - None EI - Extractor Filament 2 (Qualitative - No setpoints associated) | |
| June 21, 2022 11:16:48 AM | End | Execution | Tune EI - 5977A SQ: - Source: - Run Count : 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated) | |
| June 21, 2022 11:16:49 AM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None |
| June 21, 2022 11:17:05 AM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None |
| June 21, 2022 11:17:10 AM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None |
| June 21, 2022 11:26:09 AM | Audit | AceClosed | Session | None |
| June 21, 2022 12:36:20 PM | Audit | AceRestarted | Session | None |
| June 21, 2022 12:36:22 PM | Audit | SessionReloaded | Session | None |
| June 21, 2022 12:36:26 PM | Start | Qualification | Session | OQ |
| June 21, 2022 12:36:26 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None |

Page 4 / 8

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| June 21, 2022 12:37:07 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None |
| June 21, 2022 12:37:08 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None |
| June 21, 2022 12:38:54 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : H:\ALSGM7_2022\SNF1_001.D |
| June 21, 2022 12:39:24 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : H:\ALSGM7_2022\SNF1_001.D |
| June 21, 2022 12:40:09 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : H:\ALSGM7_2022\SNF1_001.D |
| June 21, 2022 12:42:04 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : H:\ALSGM7_2022\SNF1_001.D |
| June 21, 2022 12:42:17 PM | Audit | AceClosed | Session | None |
| June 21, 2022 12:33:31 PM | Audit | AceRestarted | Session | None |
| June 21, 2022 12:33:33 PM | Audit | SessionReloaded | Session | None |
| June 21, 2022 12:33:37 PM | Start | Qualification | Session | OQ |
| June 21, 2022 12:33:37 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None |

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| June 21, 2022 12:34:44 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF1_001.D |
| June 21, 2022 12:36:26 PM | End | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 1 |
| June 21, 2022 12:37:11 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None |
| June 21, 2022 12:38:15 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:38:30 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:38:45 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:39:00 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:39:14 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-7
 Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| June 21, 2022 12:39:45 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:40:16 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:40:40 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:41:09 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |
| June 21, 2022 12:41:29 PM | End | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Run Count : 1 |
| June 21, 2022 12:42:30 PM | Audit | TestUnlocked | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Deviation filed for Run Count : 1 |
| June 21, 2022 12:42:30 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None |
| June 21, 2022 12:42:35 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : E:\ALSGM7_2022\SNF2_001.D |

User Name: supasak.nimsongtham
Hostname: 5CG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|--|--------------------------------|
| June 21, 2022 12:42:45 PM | End | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Run Count : 2 |
| June 21, 2022 12:42:50 PM | End | Qualification | Session | QQ |
| June 21, 2022 12:42:50 PM | Start | Reporting | Session | None |
| June 21, 2022 12:45:17 PM | Audit | AceClosed | Session | None |
| June 21, 2022 1:57:47 PM | Audit | AceRestarted | Session | None |
| June 21, 2022 1:57:50 PM | Audit | SessionReloaded | Session | None |
| June 21, 2022 1:57:56 PM | Start | Qualification | Session | QQ |
| June 21, 2022 2:02:42 PM | Audit | Reporting | Session | Report Generated : Certificate |

Certificate of System Qualification

GC-OQ

| | |
|----------------|------------|
| REVIEW BY | Sarasat M. |
| APPROVED BY | KL AL |
| NEXT CAL. DATE | 20 Apr 23 |

System ID: GC-5
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phattanakan 40, Phattanakan Rd., Suan Luang, Bangkok 10250

Date: October 20, 2021 10:15:57 AM
EQP Name: AgilentRecommended
EQP Revision: GC.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: 0.3 psi /5 minutes

Agilent Recommended: ≥ -2.0 and ≤ 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Date: October 20, 2021 10:15:57 AM

System ID: GC-5

Setpoint Status:

Pass

Setpoint Actual

Inlet Pressure: 25.0 psi 24.9 psi

Accuracy: 0.1 psi

Agilent Recommended: ≤ 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name:

7890

Front

FID

Setpoint Status:

Pass

Flow Type:

Fuel

Setpoint:

30.0

mL/min

Measured Flow:

30.0

mL/min

Accuracy:

0.0

mL/min

Agilent Recommended:

≤

10.0

% setpoint

(

3.0

mL/min

)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status:

Pass

Flow Type:

Oxidizer

Setpoint:

400.0

mL/min

Measured Flow:

390.3

mL/min

Accuracy:

9.7

mL/min

Agilent Recommended:

≤

10.0

% setpoint

(

40.0

mL/min

)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status:

Pass

Flow Type:

Makeup

Setpoint:

25.0

mL/min

Measured Flow:

24.5

mL/min

Accuracy:

0.5

mL/min

Agilent Recommended:

≤

10.0

% setpoint

(

2.5

mL/min

)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Date:

October 20, 2021 10:15:57 AM

System ID:

GC-5

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 231.2 °C

Accuracy: 1.2 °C

Agilent Recommended: ≥ -1.0 % setpoint in K (-5.0 °C) ≤ 1.0 % setpoint in K (5.0 °C)**Setpoint Status:** Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 100.4 °C

Accuracy: 0.4 °C

Agilent Recommended: ≥ -1.0 % setpoint in K (-3.7 °C) ≤ 1.0 % setpoint in K (3.7 °C)**Overall GC Oven Temperature Accuracy Test Status**

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 100.4 °C

Stability: 0.0 °C

Agilent Recommended: ≤ 0.5 **Overall GC Oven Temperature Stability Test Status**

Pass

Scouting Run

| | | | | |
|-----------------------------|-----------------|-----|---------|-----|
| Tested Combination1 | Front | SSL | / Front | FID |
| | Injection Tower | | | |
| Name: | 7683B | | | |
| Setpoint Status: | Completed | | | |
| Injection Volume on Column: | 1.0 | uL | | |
| Overall Scouting Run Status | Completed | | | |

Noise and Drift

| | | | | |
|-------------------------------------|------------|------|---------|------|
| Tested Combination1 | Front | SSL | / Front | FID |
| Name: | 7890 | | | |
| Setpoint Status: | Pass | | | |
| Base Signal: | 20.2 | pA | | |
| | ASTM Noise | | Drift | |
| | pA | | pA/Hr | |
| | 0.05 | | 0.50 | |
| Agilent Recommended: | <= | 0.10 | <= | 2.50 |
| Status: | Pass | | Pass | |
| Overall Noise and Drift Test Status | Pass | | | |

Injection Precision

| | | | | |
|---------------------|-------|-----|---------|-----|
| Tested Combination1 | Front | SSL | / Front | FID |
| Name: | 7683B | | | |

Setpoint Status:

Pass

Injection Volume on Column:

1.0 uL

Area RSD:

0.52 %

Retention Time RSD:

0.22 %

Agilent Recommended:

<= 3.00

<= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination1

Front

SSL

/ Front

FID

Injection Tower

Name:

7890

Setpoint Status:

Pass

Signal to Noise:

1258310

Agilent Recommended:

>= 300000

Overall Signal to Noise Test Status

Pass

Date:

October 20, 2021 10:15:57 AM

System ID:

GC-5

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

| | |
|------------------------|-----------------------------------|
| System ID | GC-5 |
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Flow Data Input | Manual Data |
| Temperature Data Input | Manual Data or Other Data Logging |

Tested Combination1

| | |
|---------------------|-----------------|
| Injection Technique | Injection Tower |
| Inlet | Front |
| Detector | Front |
| LTM Included? | No |

Sampler 1

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Injection Tower |
| Name | 7683B |
| Model Number | G2913A |
| Serial Number | CN00259643 |
| Firmware Revision | A.11.03 |
| Usage | Sample Injection |
| Location | Front |
| Syringe Volume (µL) | 10 |

Sampler 2

| | |
|-------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Tray |
| Name | 7683A |
| Model Number | G2614A |
| Serial Number | CN81347892 |
| Firmware Revision | A.02.01 |

Mainframe 1

| | |
|------------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Model Number | G3440A |
| Serial Number | US10813027 |
| Firmware Revision | A.01.12.1 |
| Component ID/Asset No. | GC-5 |
| Oven Type | Standard |

Inlet 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | SSL |
| Location | Front |
| Carrier Gas | Helium |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes |

Detector 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | FID |
| Adapter | Capillary |
| Control Type | Electronic Pressure Control (EPC) |
| Location | Front |
| Makeup Gas | Nitrogen |

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

| | |
|--------------------------|---|
| Full Name of Signer: | Suriya Thongkaew |
| Logged On User Name: | suriya.thongkaew@non.agilent.com |
| Signature Creation Date: | October 20, 2021 |
| Reason for Signature: | Executed protocol and published this original version of document |

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This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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User Name: suriya.thongkaew
 Hostname: ASBKW7029

System Id: GC-5
 Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|---|---|
| October 19, 2021 10:37:29 AM | Audit | SessionCreated | Session | None |
| October 19, 2021 10:37:29 AM | Start | Configuration | Session | None |
| October 19, 2021 10:37:30 AM | Audit | Entitlement | Licensing | Session identifier generated: 0800-0002-0000-1YQP-0M4 G |
| October 19, 2021 10:45:44 AM | Audit | Entitlement | Licensing | Successfully unlocked session identified by 0800-0002-0000-1YQP-0M4 G with unlock code CZR6-QXE5-0GQD-6681-68 3G |
| October 19, 2021 10:57:00 AM | Audit | EqpLoaded | Session | EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.51/Gc.02.51.eqp], EQP File Name: [Gc.02.51.eqp], EQP Name: [AgilentRecommended] |
| October 19, 2021 10:58:11 AM | End | Configuration | Session | None |
| October 19, 2021 10:58:14 AM | Start | Qualification | Session | OQ |
| October 19, 2021 10:58:14 AM | Start | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | None |
| October 19, 2021 10:59:07 AM | End | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | Run Count : 1 |

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User Name: suriya.thongkaew
 Hostname: ASBKKW7029

System Id: GC-5
 Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|--|----------------------|
| October 19, 2021 11:11:55 AM | Start | Execution | Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | None |
| October 19, 2021 11:28:02 AM | End | Execution | Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | Run Count : 1 |
| October 19, 2021 11:28:08 AM | Start | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | None |
| October 19, 2021 11:28:15 AM | End | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | Run Count : 1 |
| October 19, 2021 11:28:17 AM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | None |
| October 19, 2021 11:45:30 AM | Audit | Data | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 19, 2021 11:45:36 AM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 19, 2021 11:45:38 AM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | None |
| October 19, 2021 11:52:52 AM | Audit | Data | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 19, 2021 11:52:54 AM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |

User Name: suriya.thongkaew

System Id: GC-5

Hostname: ASBKKW7029

Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|---|----------------------|
| October 19, 2021 11:52:55 AM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | None |
| October 19, 2021 12:03:38 PM | Audit | Data | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Manual Data Entry |
| October 19, 2021 12:03:39 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| October 19, 2021 12:03:42 PM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| October 19, 2021 12:23:23 PM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| October 19, 2021 12:23:24 PM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| October 19, 2021 12:23:28 PM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| October 19, 2021 12:33:48 PM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| October 19, 2021 12:33:50 PM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |

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User Name: suriya.thongkaew

System Id: GC-5

Hostname: ASBKKW7029

Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|---|---|
| October 19, 2021 12:33:53 PM | Start | Execution | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | None |
| October 19, 2021 12:54:48 PM | Audit | Data | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | Manual Data Entry |
| October 19, 2021 12:54:49 PM | End | Execution | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | Run Count : 1 |
| October 19, 2021 12:54:52 PM | Start | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | None |
| October 19, 2021 4:48:40 PM | Audit | AceClosed | Session | None |
| October 20, 2021 9:34:06 AM | Audit | AceRestarted | Session | None |
| October 20, 2021 9:34:08 AM | Audit | SessionReloaded | Session | None |
| October 20, 2021 9:34:12 AM | Start | Qualification | Session | OQ |
| October 20, 2021 9:34:12 AM | Start | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | None |
| October 20, 2021 9:35:51 AM | Audit | Data | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | Data files Path : C:\Chem32\1\DATA\OQPV20 21\OQPV2021 2021-10-19 17-23-14\SCOUTING001.D\F ID1A.ch |

User Name: suriya.thongkaew

System Id: GC-5

Hostname: ASBKW7029

Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|--|---|
| October 20, 2021 9:36:24 AM | End | Execution | GC Scouting Run - Injection Tower, Front SSL, Front FID: - Part of System Preparation - No limits associated | Run Count : 1 |
| October 20, 2021 9:36:27 AM | Start | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | None |
| October 20, 2021 9:37:19 AM | Audit | Data | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021-10-19-17-23-14\NSDRF001.D\FID1A.ch |
| October 20, 2021 9:37:30 AM | End | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Run Count : 1 |
| October 20, 2021 9:37:32 AM | Start | Execution | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | None |
| October 20, 2021 9:37:53 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021-10-19-17-23-14\INJPREC002.D\FID1A.ch |
| October 20, 2021 9:37:53 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021-10-19-17-23-14\INJPREC003.D\FID1A.ch |

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User Name: suriya.thongkaew

System Id: GC-5

Hostname: ASBKKW7029

Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|-----------------------------|-------------------|--------------------|--|---|
| October 20, 2021 9:37:53 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC004.D\FID 1A.ch |
| October 20, 2021 9:37:53 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC005.D\FID 1A.ch |
| October 20, 2021 9:37:53 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC006.D\FID 1A.ch |
| October 20, 2021 9:37:53 AM | Audit | Data | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC007.D\FID 1A.ch |
| October 20, 2021 9:38:21 AM | End | Execution | Injection Precision - Injection Tower, Front SSL, Front FID: - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% | Run Count : 1 |
| October 20, 2021 9:38:28 AM | Start | Execution | Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000 | None |
| October 20, 2021 9:38:42 AM | Audit | Data | Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000 | Data files Path : C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\SIGTONS001.D\FID 1A.ch |
| October 20, 2021 9:38:50 AM | End | Execution | Signal to Noise - Injection Tower, Front SSL, Front FID: - Detector FID - L: >= 300000 | Run Count : 1 |

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User Name: suriya.thongkaew

System Id: GC-5

Hostname: ASBKkW7029

Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|------------------------------|-------------------|--------------------|---------------------|-----------------------------------|
| October 20, 2021 9:38:54 AM | End | Qualification | Session | OQ |
| October 20, 2021 9:38:54 AM | Start | Reporting | Session | None |
| October 20, 2021 10:15:14 AM | Audit | Reporting | Session | Report Generated : Certificate |



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH1222

Page.: 1 of 2

Certificate of Calibration

| | |
|-------------------------|---|
| Equipment : | pH Meter |
| Manufacturer : | Mettler Toledo |
| Model : | Seven Compact S220 |
| Serial No. : | B520948426 |
| ID No. : | BKK_EN0072 |
| Condition As-Received: | Used Item |
| Received Date : | 09 September 2022 |
| Calibration Date : | 12 September 2022 |
| Reference : | 2209-0312DSC-1 |
| Submitted by : | ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 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) |

| | |
|----------------|------------------|
| REVIEW BY | <u>Sinluk P.</u> |
| APPROVED BY | <u>KL AL</u> |
| NEXT CAL. DATE | <u>12/03/24</u> |

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 15 September 2022

The Uncertainties are for a confidence probability of approximately 95%

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.



Cert. No.: 22CH1222

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

| <u>Instrument</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 54030049 | 130RC116 | 22E2769 | 24 Aug 2023 |

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

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

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

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| 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 (\pm mV) | Coverage factor <i>k</i> |
|------------------------------|---------------|------------------------|----------------|--------|---|-----------------------------|
| | pH | mV | mV | pH | | |
| pH Meter S/N.: B520948426 | 4.000 | 177.48 | 177.4 | 4.000 | 0.058 | 2.00 |
| | 7.000 | 0.00 | 0.0 | 7.000 | 0.058 | 2.00 |
| | 10.000 | -177.48 | -177.5 | 10.000 | 0.058 | 2.00 |

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 <i>k</i> |
|-------------------------------------|-----------------------------|-------------------|---------------------------|--|-----------------------------|
| pH Electrode S/N.: PCE-86-EX1001 | 4.008 | 3.999 | 153.9 | 0.0055 | 2.09 |
| | 6.985 | 7.017 | -13.7 | 0.0084 | 2.00 |
| | 10.008 | 9.996 | -179.0 | 0.0078 | 2.06 |

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 %.

-oOo-

Malu.

a 1126274

ภาคผนวก จ

สำเนาหนังสืออนุญาตขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน



ที่ อก ๐๓๑๐(๑)/ ๑๐๖๕

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ เขตราชเทวี
กรุงเทพมหานคร ๑๐๔๐๐

๒๘ มกราคม ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๓๐ กรกฎาคม ๒๕๖๓

- สิ่งที่ส่งมาด้วย ๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๑ แผ่น
๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ แผ่น
๓. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุ
หนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๔ สถานที่ตั้งเลขที่ ๑๐๔
ซอยพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร
ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย)
จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

- ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย ตามสิ่งที่ส่งมาด้วย ๑
ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย ตามสิ่งที่ส่งมาด้วย ๒
ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๕๙ รายการ น้ำใต้ดิน
จำนวน ๑๒๖ รายการ อากาศเสีย ๑๖ รายการ สิ่งปฏิภณหรือวัสดุที่ไม่ใช่แล้ว จำนวน ๓๕ รายการ และดิน
จำนวน ๑๒๕ รายการ รวมทั้งสิ้นจำนวน ๓๖๑ รายการ ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะหมดอายุในวันที่ ๒ กันยายน ๒๕๖๖ หากประสงค์จะต่ออายุหนังสือ
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอ
ต่อกรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์
เอกชน ซึ่งคำขอต่ออายุดังกล่าวขอรับได้ที่กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

๒๒๒

(นายศิระ จันทร์เจ็ด)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน
ผู้อำนวยการกองวิจัยและเฝ้าระวังมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเฝ้าระวังมลพิษโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๒๐๒ ๔๑๔๖ ๐ ๒๒๐๒ ๔๐๐๒

โทรสาร ๐ ๒๓๔๔ ๓๒๐๘ ๐ ๒๓๔๔ ๓๔๑๕

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/

ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย

- ๑) นางสาวยุพาพร จันทร์เปล่ง
๒) นางสาวชัชชัย โกมารกุล ณ นคร
๓) นายศรายุทธ จิตรานนท์
๔) นางสาวกนกกร เอนก
๕) นายสุริยา สอนแก้ว
๖) นายวิชาญ ชุมทรัพย์

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๐

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๑

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๒

ทะเบียนเลขที่ ว-๒๐๔-ค-๔๗๐๓

ทะเบียนเลขที่ ว-๒๐๔-ค-๖๑๑๒

ทะเบียนเลขที่ ว-๒๐๔-ค-๖๑๑๓

๒๒๒

(นายศิระ จันทร์เจ็ด)

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน
ผู้อำนวยการกองวิจัยและเฝ้าระวังมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอนแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ ออก ๐๓๑๐(๑) / ๑๐๖๙

ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย

- ๑) นางสาวจินดา โชกุลธรรม
- ๒) นางสาวสาวตรี น้อยเสงี่ยม
- ๓) นางสาวชนัญญาญจน์ อัมมขม
- ๔) นางสาวนรินทร์ สายเส็ง
- ๕) นางสาวนันทวิทย์ สมบูรณ์
- ๖) นางสาวศรีณยา เกลิมธำรงค์
- ๗) นางสาวสรารักษ์ มงคลจิรวุฒิ
- ๘) นางสาวศิริลักษณ์ พึ่งแพง
- ๙) นายนพพงศ์ จันทร์พันธุ์
- ๑๐) นายเศรษฐ์ โกมลย์
- ๑๑) นายธันวา จรียา
- ๑๒) นางสาวเกศรินทร์ แก้วมัน
- ๑๓) นางสาวสุวิมล ชัยเรืองวุฒิ
- ๑๔) นางสาวสุชาดา ธรรมถาวร
- ๑๕) นางสาวเนมิกา ชัยเดชธนกุล
- ๑๖) นางสาวศศิธร หมูสวัสดิ์
- ๑๗) นางสาวเสาวลักษณ์ ภูณาทำพร
- ๑๘) นายอภิสิทธิ์ สิงหา
- ๑๙) นายศักดิ์สิทธิ์ ไพศาลพิสุทธิ
- ๒๐) ว่าที่ร้อยตรีหญิง พรรณิภา ขำเจริญ
- ๒๑) นางจิตตา คำแก้ว
- ๒๒) นางสาวอรวรรณ รักยง
- ๒๓) นางสาวนพรัตน์ แยมกรานต์
- ๒๔) นายจุลเดช วารินทร์
- ๒๕) นางสาวดาญรัตน์ ร้องคำ
- ๒๖) นายนคร สุขเจริญ
- ๒๗) นายบัญชา นามเขตต์
- ๒๘) นายพรมณ์ ศรีปัตเนตร
- ๒๙) นายอุทิศ อุ่นลิ้ม
- ๓๐) ว่าที่ร้อยตรี เกลิมเกียรติ อมรศรีเสริม
- ๓๑) นางสาววริยา สร้างนา
- ๓๒) นายอนุพงศ์ รตินศรีประเสริฐ
- ๓๓) นางสาวจุฑารัตน์ โอนสันเทียะ
- ๓๔) นางสาวจารุวรรณ พิมพ์อภิลักขิต

- ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๐๘
ทะเบียนเลขที่ ว-๒๐๔-จ-๔๗๐๙
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ทะเบียนเลขที่ ว-๒๐๔-จ-๖๑๔๒
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๖๖

(นายศิระ จันทร์เจิด)

๓๕) นางสาวปรังค์ทิพย์...

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปตท.ปิโตรเคมีและปิโตรเลียม

- ๒ -

- ๓๕) นางสาวปรังค์ทิพย์ กิจไพศาลศักดิ์
- ๓๖) นางสาวเดือนใจ ทางกลาง
- ๓๗) นางสาวจิราพร ศิริเวช
- ๓๘) นายวรารักษ์ ผูกกริช
- ๓๙) นายทง วีริยะสทกิจ
- ๔๐) นายณิต เจนจบ
- ๔๑) นายคณิศร ขำเพชร
- ๔๒) นายอรรคพล นิยมวิทยาพันธ์
- ๔๓) นายภูวิช พรหมสะอาด
- ๔๔) นายธนเดช โกคาพิพัฒน์
- ๔๕) นายขวฤทธิ์ วงษ์จันทร์
- ๔๖) นายอาทิตย์ ศรีเสน
- ๔๗) นายเจดตินทร์ คงศักดิ์ไทย
- ๔๘) นายจรัส บุญย้ง
- ๔๙) นายธนาภิต เอนก
- ๕๐) นายอภิวัฒน์ ทุมหนู
- ๕๑) นางสาวสุภาขวัญ มาก
- ๕๒) นางสาวทัตพร ขวาลสมบูรณ์
- ๕๓) นางสาวอติมา บุญเพ็ง
- ๕๔) นางสาวกนกอร เข้มเพ็ชร
- ๕๕) นางสาวพัชรียา หงษ์สมดี
- ๕๖) นางสาวภาณิดา สุวงศ์ตระกูล
- ๕๗) นางสาวภาณุมาศ นามวัฒน์
- ๕๘) นางสาวอุไรรัตน์ หังสร้างแป้น
- ๕๙) นายธีรวัฒน์ ปวงสุข
- ๖๐) นายอิทธิพล ยะโส
- ๖๑) นายประจักษ์ วรรณสุขชัย
- ๖๒) นายชยธร พวงทิพย์
- ๖๓) นางสาวกนกวรรณ จันทบาล
- ๖๔) นางสาวเกษร หล้าบุญ
- ๖๕) นายสิทธิโชค ธงเงิน
- ๖๖) นางสาววรรณ ใจบุญ
- ๖๗) นางสาวพรรณธิดา ทุมคง
- ๖๘) นางสาวศรณีย์ ยิ่งดี
- ๖๙) นายฉวีกร ศรีวิริยะ
- ๗๐) นายสุวิชา ทองอ่อน
- ๗๑) นายวิญญู บุญตะนัย

- ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๗๙
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๐
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๒
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๓
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๔
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๕
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๖
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๗
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๘
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๘๙
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๐
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๑
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๒
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ทะเบียนเลขที่ ว-๒๐๔-จ-๗๐๙๖
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ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๑๑
ทะเบียนเลขที่ ว-๒๐๔-จ-๗๑๑๓

(นายศิระ จันทร์เจิด)

๗๒) นายสมบูรณ์...

นักวิทยาศาสตร์ชำนาญการพิเศษ รักษาการแทน
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปตท.ปิโตรเคมีและปิโตรเลียม

๗๒) นายสมบุรณ์ บุตรจันทร์
๗๓) นายวิรัตน์ ไชยชนะรา
๗๔) นายอนุเบศร์ เพิ่มพูน
๗๕) นายจิรณัฐ ขาวละออ
๗๖) นายสมโภช วันสา
๗๗) นายอัสรี นามบุรี
๗๘) นายณัฐนันท์ ปานประเสริฐ
๗๙) นายอัครเศรฐ จอสาว
๘๐) นายประเสริฐ สุระขันธ
๘๑) นายภูกุล จันทรเนียม
๘๒) นายพิรพงษ์ ทองคุณปรีดา
๘๓) นายอนุพล ทองนุช
๘๔) นายอนุวัฒน์ ม่วงแพ
๘๕) นายเจตศรวุฒิ ปิตตะมะ
๘๖) นายกฤษณะ สายวรรณ
๘๗) นายพิชัย บุญยงค์
๘๘) นายภาณุพงศ์ โอเมวงค์
๘๙) นายสามารถ คุ่มปลี
๙๐) นายสัณชัย โกศรีนาม
๙๑) นายณัฐวุฒิ ศรีประเสริฐ
๙๒) นายชลธิช นาคพนม
๙๓) นายพงศธร ชัยทิพย์
๙๔) ว่าที่ร้อยตรี ภาณุพงศ์ แสนศรี
๙๕) นายสิทธิโชค หาสิดา
๙๖) นายธนากร อินสุตา
๙๗) นางสาววรรณิษา ขาติวันชัย
๙๘) นางสาวพิมพ์ตะวัน มินากุล
๙๙) นางสาวเพชรรัตน์ สิงห์สมบูรณ์
๑๐๐) นางสาวชญาณีน พรหมจันทร์
๑๐๑) นายกิตติ ทวีราช
๑๐๒) นายจักริน หมั่นวิชา
๑๐๓) นายฉัตรชัย สุขเปี้ย
๑๐๔) นายณรนนท์ ต๊ะทองคำ
๑๐๕) นายศุภพล สนนอก
๑๐๖) นายทักษ์ดนัย อุบลศรี
๑๐๗) นายธนศร นามะกุลณา
๑๐๘) นายธิตพงษ์ บัวแดง

ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๑๔
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ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๒
ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๓

(นายศิระ จันทรเจ็ด)

นักวิทยาศาสตร์ชำนาญการพิเศษ วิชาการการแพทย์
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
เปิดพิจารณาและลงนาม

๑๐๙) นายณนทชัย...

๑๐๙) นายณนทชัย อุบลัมภ
๑๑๐) นายณัฐพล คุณสุทธิ
๑๑๑) นายณันทวัฒน์ สาริน
๑๑๒) นายปิยะนัฐ พลมะศรี
๑๑๓) นายพงศ์สิริ โสมเขียว
๑๑๔) นายพีรพัฒน์ กำคำ
๑๑๕) นายภาณุพงศ์ มานิตย์
๑๑๖) นายมงคล ผลาพิทย์
๑๑๗) นายมนันท์ พูลศิริ
๑๑๘) นายสิรินันท์ ทองอิน
๑๑๙) นายอนเนชา หันสมัย
๑๒๐) นายอดิศักดิ์ ผมไผ
๑๒๑) นายอนันตชัย วิสลม
๑๒๒) นายณัฐดนัย เจือละออง
๑๒๓) นายวรารุช คีนัก
๑๒๔) นายแสงตะวัน นตะสัด
๑๒๕) นายยุทธพงศ์ รัตนะ
๑๒๖) นายชัยณวุฒิ ไชยชนะนิจ
๑๒๗) นายวิศรุต ศรีธรรมมา
๑๒๘) นายณนทกร เมื่อกผ่อง
๑๒๙) นายกำชัย สุทธะ
๑๓๐) นางสาวณัฐภรณ์ รักทะเล
๑๓๑) นางสาวประภาภรณ์ บุตรพรม
๑๓๒) นางสาวนิลาวัลย์ นามพรม
๑๓๓) นางสาวพัชรินทร์ แสนสร้อย
๑๓๔) นายไพโรจน์ เปี่ยมพิมาย
๑๓๕) นางสาวศุภมาศ ทองมาก
๑๓๖) นางสาวลลิตา จิตรสว่าง
๑๓๗) นางสาวไมพร เลิกภูเขียว
๑๓๘) นางสาวกฤติมาพร คำมีแก่น
๑๓๙) นางสาวสกุลรัตน์ ภาควุฒิ
๑๔๐) นางสาวกาญจนา คงคุณ
๑๔๑) นางสาวไพรินทร์ ศรีรูป
๑๔๒) นางสาวทิพนพร ฝอยปัญญา
๑๔๓) นางสาวสาธิตา ปานทอง
๑๔๔) นางสาวอริสา ทองนวล
๑๔๕) นางสาวอริยา คำคล่อง

ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๔
ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๕
ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๖
ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๗
ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๕๔๘
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ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๖๐๐
ทะเบียนเลขที่ ๖-๒๐๔-จ-๗๖๐๑
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(นายศิระ จันทรเจ็ด)

นักวิทยาศาสตร์ชำนาญการพิเศษ วิชาการการแพทย์
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
เปิดพิจารณาและลงนาม

๑๔๖) นางสาวสุดาภรณ์...

| | |
|---------------------------------|----------------------------|
| ๑๔๖) นางสาวชุตารณ สุนทรสนาน | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๕ |
| ๑๔๗) นางสาวสุดารัตน์ นนทประสาธ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๖ |
| ๑๔๘) นางสาวรัชนิกร เนียมกลาง | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๗ |
| ๑๔๙) นางสาวกัญญารัตน์ ศรีนิลหา | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๘ |
| ๑๕๐) นางสาวอัญชลี คำจันทร์ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๓๙ |
| ๑๕๑) นายบุญฤทธิ์ เอี่ยมเทศ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๐ |
| ๑๕๒) นายศิริวัฒน์ พานิชย์ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๑ |
| ๑๕๓) นางสาวศุภรดา ปันมยุรา | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๒ |
| ๑๕๔) นางสาวพาดิ คุณนนาน | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๓ |
| ๑๕๕) นางสาวจิราเจต พองดา | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๔ |
| ๑๕๖) นางสาวกนกภรณ์ อูระ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๕ |
| ๑๕๗) นางสาวอารยา มีชัย | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๖ |
| ๑๕๘) นางสาวจิตสุภา ประเทืองสุข | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๗ |
| ๑๕๙) นางสาวอริสา วิริยขันติธรรม | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๘ |
| ๑๖๐) นางสาววิชชุดา นาคผจญ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๔๙ |
| ๑๖๑) นางสาวพนิดา ยอดอินทร์ | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๐ |
| ๑๖๒) นางสาวนันทิยา จันทะลุน | ทะเบียนเลขที่ ว-๒๐๔-จ-๙๒๕๑ |



(นายศิริระ จันทรเจต)

นักวิทยาศาสตร์ชำนาญการพิเศษ วิชาการการแพทย์
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบลอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/ ๑๐๖๕

ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ขอขยายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๖๑ รายการ

น้ำเสีย จำนวน 59 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---------------------------|---|
| 1 | Aldicarb | High-Performance Liquid Chromatographic Method ^[4] |
| 2 | Aldicarb Sulfone | High-Performance Liquid Chromatographic Method ^[4] |
| 3 | Aldicarb Sulfoxide | High-Performance Liquid Chromatographic Method ^[4] |
| 4 | Aldrin | Liquid-Liquid Extraction, Gas Chromatographic Method ^[4] |
| 5 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4] |
| 6 | Barium | 1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4] |
| 7 | α-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method ^[4] |
| 8 | β-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method ^[4] |
| 9 | δ-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method ^[4] |
| 10 | γ-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method ^[4] |
| 11 | Biochemical Oxygen Demand | 1) 5-Day BOD Test, Azide Modification Method ^[4] 2) 5-Day BOD Test, Membrane Electrode Method ^[4] |
| 12 | Carbaryl | High-Performance Liquid Chromatographic Method ^[4] |
| 13 | Carbofuran | High-Performance Liquid Chromatographic Method ^[4] |
| 14 | Cadmium | 1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[4] |
| 15 | Chemical Oxygen Demand | 1) Closed Reflux, Colorimetric Method ^[4] 2) Closed Reflux, Titrimetric Method ^[4] |
| 16 | Chlordane | Liquid-Liquid Extraction, Gas Chromatographic Method ^[4] |
| 17 | Chromium | 1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[4] |
| 18 | Color | ADMI Weighted-Ordinate Spectrophotometric Method |



(นางริภาณูจน์ ฉัตรสกุลวิไล)

19 Copper...

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

| ลำดับที่ | สารมลพิษ | 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 ^[3] |
| 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
(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

44 Methomyl...

| ลำดับที่ | สารมลพิษ | 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] |

น้ำได้ดิน จำนวน 126 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|--------------|--|
| 1 | Acenaphthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 2 | Acetone | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] |

วิมล
(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

3 Aldrin...

| ลำดับที่ | สารมลพิษ | 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] |

วิมล

18 Bis(2-ethylhexyl)phthalate...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
กรมควบคุมมลพิษ

| ลำดับที่ | สารมลพิษ | 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] Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 22 | Butyl Benzyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 23 | Cadmium | 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] |

วิมล

34 Chromium (III)...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
กรมควบคุมมลพิษ

| ลำดับที่ | สารมลพิษ | 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] |

วิธีวิเคราะห์

51 cis-1,2-Dichloroethylene...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และประเมินผลกระทบต่อสุขภาพ

| ลำดับที่ | สารมลพิษ | 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] |

วิธีวิเคราะห์

68 Fluorene...

(นางริกาญจน์ ฉัตรสกุลวิไล)

ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และประเมินผลกระทบต่อสุขภาพ

| ลำดับที่ | สารมลพิษ | 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] |

วิธีพิมพ์

84 Methanol...

(นางริกาญจน์ อัครสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---|---|
| 84 | Methanol | 1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 85 | Methoxychlor | 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 86 | Methyl Bromide | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 87 | Methylene Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 88 | 2-Methylphenol | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 89 | 2-Methylnaphthalene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 90 | Methyl tert-Butyl Ether | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 91 | Naphthalene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 92 | Nickel | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[4] |
| 93 | Nitrobenzene | 1) Digestion, Inductively Coupled Plasma Method ^[4] 2) Digestion, Inductively Coupled Plasma/ 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] |

วิธีพิมพ์

97 Pentachlorophenol...

(นางริกาญจน์ อัครสกุลวิไล)

ผู้อำนวยการศูนย์มาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม

| 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 ₅ -C ₈) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[13,24] |
| 110 | TPH (C ₈ -C ₁₆) | Solvent Extraction, Gas Chromatographic Method ^[9,21] |
| 111 | TPH (C ₁₆ -C ₃₅) | 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] |

วิมล

114 1,1,2-Trichloroethane...

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และทะเบียนห้องปฏิบัติการ

| 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 | 2,4,5-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 | o-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] |

อากาศเสีย (ปล่อยระบาย) จำนวน 16 รายการ


| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 1 | Antimony | Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5] |
| 2 | Arsenic | Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5] |

วิมล

3 Carbon Monoxide...

(นางริกาญจน์ ฉัตรสกุลวิไล)
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และทะเบียนห้องปฏิบัติการ


| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-----------------------------|--|
| 3 | Carbon Monoxide | 1) Sampling Bag Non-Dispersive Infrared Method ^[5] 2) Non-Dispersive Infrared Method ^[5] 3) Instrumental Analyzer Method ^[5] |
| 4 | Chlorine | 1) Absorption Sampling, Ion Chromatographic Method ^[5] 2) Isokinetic Sampling, Ion Chromatographic Method ^[5] |
| 5 | Copper | Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5] |
| 6 | Dioxins | Isokinetic Sampling, Analysis by ISO/IEC 17025 Accredited Laboratory or Analysis by Department of Industrial Works Registered Laboratory (Dioxins/Furans Analysis Approved) ^[5] |
| 7 | Hydrogen Chloride | 1) Absorption Sampling, Ion Chromatographic Method ^[5] 2) Isokinetic Sampling, Ion Chromatographic Method ^[5] |
| 8 | Hydrogen Sulfide | Absorption Sampling, Iodometric Method ^[5] |
| 9 | Lead | Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5] |
| 10 | Mercury | 1) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[5] 2) Isokinetic, Digestion, Inductively Coupled Plasma Method ^[5] |
| 11 | Opacity | Ringelmann's Method ^[2] |
| 12 | Oxides of Nitrogen | 1) Absorption Sampling, Phenoldisulfonic Acid Method ^[5] 2) Chemiluminescence Method ^[5] 3) Instrumental Analyzer Method ^[5] |
| 13 | Sulfur Dioxide | 1) Absorption Sampling, Barium-Thorin Titrimetric Method ^[5] 2) UV Fluorescence Method ^[5] 3) Instrumental Analyzer Method ^[5] |
| 14 | Sulfuric Acid | Isokinetic Sampling, Barium-Thorin Titrimetric Method ^[5] |
| 15 | Total Suspended Particulate | Isokinetic Sampling, Gravimetric Method ^[5] |
| 16 | Xylene | Adsorption Sampling, Gas Chromatographic Method ^[5] |


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สิ่งปฏิกูล...

สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน 35 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-----------|--|
| 1 | Aldrin | 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 ^[22,31] |
| 2 | Antimony | 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] |
| 3 | Arsenic | 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] |
| 4 | Barium | 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] |
| 5 | Beryllium | 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] |


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 และทะเบียนห้องปฏิบัติการ

6 Cadmium...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------------|---|
| 6 | Cadmium | 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] |
| 7 | Chlordane | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,19,25] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] |
| 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 ^[1,6,15,17] 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 ^[7,8,15,17] 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^[7,8, 16,17] |
| 10 | Chromium (VI) | 1) Waste Extraction, Colorimetric Method ^[1,6,17] 2) Alkaline Digestion, Colorimetric Method ^[8,17] |

วิมล

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กรมควบคุมมลพิษ

11 Cobalt...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 11 | Cobalt | 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] |
| 12 | Copper | 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] |
| 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 ^[22,31] |
| 14 | DDD | 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 ^[22,31] |
| 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 ^[22,31] |
| 16 | DDT | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] |

วิมล

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กรมควบคุมมลพิษ

2) Soxhlet...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|------------|--|
| 17 | Dieldrin | 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] |
| 18 | Endrin | 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] |
| 19 | Heptachlor | 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method ^[1,9,25] |
| 20 | Lead | 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] |
| 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 ^[22,31] |
| 22 | Mercury | 1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method ^[1,6,18] |

วิธีวิเคราะห์

2) Waste Extraction...

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| 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 ^[18] 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method ^[19] 6) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^[20] |
| 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 ^[22,31] |
| 25 | Molybdenum | 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] |
| 26 | Nickel | 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] |

วิธีวิเคราะห์

27 Polychlorinated...

(นางริกาญจน์ ฉัตรสกุลวิไล)


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| 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',3,5,5',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',3,4,4',5,6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method ^[1,9,23] 2) Soxhlet Extraction, Gas Chromatographic Method ^[10,23] 3) Automated Soxhlet Extraction, Gas Chromatographic Method ^[22,31] |


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28 Pentachlorophenol...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-------------------|--|
| 28 | Pentachlorophenol | 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 ^[22,31] |
| 29 | pH | Electrometric Method ^[29,30] |
| 30 | Selenium | 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] |
| 31 | Silver | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method ^[1,6,15] 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method ^[1,6,16] |
| 32 | Thallium | 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] |
| 33 | Toxaphene | 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 ^[22,31] |
| 34 | Vanadium | 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] |


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4) Digestion...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 35 | Zinc | 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] 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] |

ดิน 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 ^[10,22] 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 ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |
| 6 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |
| 7 | Atrazine | 1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31] |
| 8 | Barium | 1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |

วิมล
(นางริกาญจน์ ฉัตรสกุลวิไล)

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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 ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |
| 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 ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |
| 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 | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------------------|--|
| 26 | Carbon tetrachloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24] |
| 27 | Chlordane | 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 ^[7,8,15,17] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method ^[7,8,16,17] |
| 35 | Chromium (VI) | Alkaline Digestion, Colorimetric Method ^[8,17] |
| 36 | Chrysene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31] |
| 37 | Cyanide | Extraction, Distillation, Colorimetric Method ^[26,27,28] |
| 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 DDE...

| ลำดับที่ | สารมลพิษ | 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 | สารมลพิษ | 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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| ลำดับที่ | สารมลพิษ | 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 ^[18] |

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และศูนย์เฝ้าระวังมลพิษ

2) Thermal...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|--|---|
| 84 | Methanol | 2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry ^[19] 3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method ^[20] Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method ^[12,24] |
| 85 | Methoxychlor | 1) Soxhlet Extraction, Gas Chromatographic Method ^[10,22] 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 ^[7,16] |
| 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 ^[10,23] 2) Automated Soxhlet Extraction, Gas Chromatographic Method ^[23,32] |

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---|--|
| | - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 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',3,5,5',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',3,4,4',5,6-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] |

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|---|--|
| 101 | Selenium | 1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |
| 102 | Silver | 1) Digestion, Inductively Coupled Plasma Method ^[7,15] 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method ^[7,16] |
| 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 ^[10,22] 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method ^[25,31] |
| 108 | TPH (C ₅ -C ₈) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method ^[14,24] |
| 109 | TPH (C ₈ -C ₁₆) | 1) Solvent Extraction, Gas Chromatographic Method ^[11,21] 2) Automated Soxhlet Extraction, Gas Chromatographic Method ^[21,31] |
| 110 | TPH (C ₁₆ -C ₃₅) | 1) Solvent Extraction, Gas Chromatographic Method ^[11,21] 2) Automated Soxhlet Extraction, Gas Chromatographic Method ^[21,31] |
| 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...

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| ลำดับที่ | สารมลพิษ | 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 ^[7,16] |
| 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 ^[7,16] |

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และทะเบียนห้องปฏิบัติการ



ที่ อก ๐๓๑๐(๓)/ ๖๔๗๐

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๒๘ มิถุนายน ๒๕๖๔

เรื่อง ขันทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน
ลงวันที่ ๒๙ เมษายน ๒๕๖๔

สิ่งที่ส่งมาด้วย เอกสารแนบท้ายหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด จำนวน ๒ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอขึ้นทะเบียน
ห้องปฏิบัติการวิเคราะห์เอกชน พร้อมรายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ เจ้าหน้าที่ประจำ
ห้องปฏิบัติการวิเคราะห์ และรายการสารมลพิษที่จะทำการวิเคราะห์ ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป
(ประเทศไทย) จำกัด ขันทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน มีเลขทะเบียน ว-๓๒๓ สถานที่ตั้งเลขที่
๖๑๖/๑๐ หมู่ที่ ๕ ตำบลแม่น้ำคู อำเภอลวกแดง จังหวัดระยอง โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์

| | | |
|--------------------------|---------------|--------------|
| ๑) นายเดช ช่างชน | ทะเบียนเลขที่ | ว-๓๒๓-ค-๙๔๔๒ |
| ๒) นางวิลาวัลย์ บริรักษ์ | ทะเบียนเลขที่ | ว-๓๒๓-ค-๙๔๔๓ |
| ๓) นายสุพจน์ สลามเต๊ะ | ทะเบียนเลขที่ | ว-๓๒๓-ค-๙๔๔๔ |

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์

| | | |
|---------------------------------|---------------|--------------|
| ๑) นางสาวนฤมล บรรจงกิจ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๔๕ |
| ๒) นางพจนา สีดา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๔๖ |
| ๓) นางสาวธนิดา กุลสุริวงศ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๔๗ |
| ๔) นายพิทยา ทองแดง | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๔๘ |
| ๕) นางชลธิชา สิบงกช | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๔๙ |
| ๖) ว่าที่ ร.ต.รมชัย ม่วงมา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๐ |
| ๗) นายวราวุฒิ พัทพา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๑ |
| ๘) นายศักดิ์รินทร์ จรัสกาย | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๒ |
| ๙) นายสุรศักดิ์ สาชิน | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๓ |
| ๑๐) นางสาวเพชรคุณ ภวภูตานนท์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๔ |
| ๑๑) นายสถาพร ธาแก้ว | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๕ |
| ๑๒) นายสุทธิดำรงค์ โชคปิตินันท์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๖ |

๑๓) นายวัลลภ...

-๒-


| | | |
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| ๑๓) นายวัลลภ หันไชยเนาว์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๗ |
| ๑๔) นางสาววนาลี เจริญตระกูล | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๘ |
| ๑๕) นางสาววนิดา ผดุงจิตต์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๕๙ |
| ๑๖) นายธนสิทธิ์ วงศ์ไชย | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๐ |
| ๑๗) นายชัยนุสรณ์ เลิศนันทกุลชัย | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๑ |
| ๑๘) นายสัจจา เพ็ชรแสง | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๒ |
| ๑๙) นายกันตภณ มณีสัมพันธ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๓ |
| ๒๐) นางสาวจันทนีย์ โกเมนชนะ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๔ |
| ๒๑) นายธารินทร์ อีอกจินดา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๕ |
| ๒๒) นายศุภณัฐ พิสัยพันธ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๖ |
| ๒๓) นายศุภชัย วงศ์สุริยฉาย | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๗ |
| ๒๔) นายปฐมพงศ์ กรสวีสดี | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๘ |
| ๒๕) นายไสว ตันโพธิ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๖๙ |
| ๒๖) นางสาวกิตติยา สัญญาอริยาภรณ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๐ |
| ๒๗) นางสาวเจษฎาพร ศรีบุญเรือง | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๑ |
| ๒๘) นางสาวมธุรินทร์ สิงห์เงา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๒ |
| ๒๙) นางสาวธิดารัตน์ ศิริมงคลโร | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๓ |
| ๓๐) นายพิพัฒน์ นิกัทธิเศรษฐ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๔ |
| ๓๑) นายศิริวิทย์ เรืองสม | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๕ |
| ๓๒) นายปารามศ สัตยาคุณ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๖ |
| ๓๓) นายณนัท ธรรมสโร | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๗ |
| ๓๔) นางสาวศุภรัตน์ โสจันทร์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๘ |
| ๓๕) นายพชรกร อินทรเสนา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๗๙ |
| ๓๖) นายทิวากร เชื้อมาก | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๐ |
| ๓๗) นายอนุรักษ์ ทองขจรศักดิ์ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๑ |
| ๓๘) นายอภิชาติ วิลาส | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๒ |
| ๓๙) นายจรัสระวี ศรีรักษา | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๓ |
| ๔๐) นายประสานมิตร เชื้อนเพชร | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๔ |
| ๔๑) นายภาณุวัฒน์ วังบง | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๕ |
| ๔๒) นายสันติ ชัยชนะ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๖ |
| ๔๓) นายสิทธิชัย แก้วเกตุ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๗ |
| ๔๔) นายทินกร กุลชาติ | ทะเบียนเลขที่ | ว-๓๒๓-จ-๙๔๘๘ |

ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๑๔ รายการ
อากาศเสีย (ปล่อยระบาย) จำนวน ๗ รายการ และน้ำใต้ดิน จำนวน ๓ รายการ รวมทั้งสิ้นจำนวน ๒๔ รายการ
ตามสิ่งที่ส่งมาด้วย

หนังสือฉบับนี้มีอายุ ๓ ปี นับจากวันที่กรมโรงงานอุตสาหกรรมออกหนังสือ หากประสงค์
จะต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบ
คำขอต่อกรมโรงงานอุตสาหกรรมภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการ
วิเคราะห์เอกชน ซึ่งคำขอต่ออายุดังกล่าวขอรับได้ที่กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ


(นางจินดา เศษศรีนทร์)
ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน
ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

๒๘ มิ.ย. ๒๕๖๔

กองวิจัยและเตือนภัยมลพิษโรงงาน
ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก
โทร. ๐ ๓๘๐๕ ๗๒๖๑-๓
ไปรษณีย์อิเล็กทรอนิกส์ airw@diw.mail.go.th

เอกสารแนบท้ายหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอนแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๓๒๓

ที่ ออก ๐๓๑๐(๓)/ ๒๔๗๐

ลงวันที่ ๒๘ มิถุนายน ๒๕๖๔

ขอขยายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๒๔ รายการ

น้ำเสีย 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 ^[2] |
| 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 ^[2] |
| 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 ^[2] 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 (ปล่องระบาย) จำนวน 7 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-------------------|--|
| 1 | Carbon Monoxide | 1) Sampling Bag, Non-Dispersive Infrared Method ^[5] 2) Instrumental Analyzer Method ^[8] |
| 2 | Hydrogen Sulfide | Absorption Sampling, Iodometric Method ^[5] |
| 3 | Opacity | Ringelmann's Method ^[3,4] |
| 4 | Oxide of Nitrogen | 1) Absorption Sampling, Phenoldisulfonic Acid Method ^[6] 2) Instrumental Analyzer Method ^[9] |
| 5 | Sulfur Dioxide | 1) Absorption Sampling, Barium-Thorin Titrimetric Method ^[5] 2) Instrumental Analyzer Method ^[10] |



(นางสาววิชุดา สัมฤทธิ์ผล)

ผู้อำนวยการ

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก

Sulfuric Acid...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|-----------------------------|--|
| 6 | Sulfuric Acid | Isokinetic Sampling, Barium – Thorin Titrimetric Method ^[6] |
| 7 | Total Suspended Particulate | Isokinetic Sampling, Gravimetric Method ^[7] |

น้ำใต้ดิน จำนวน 3 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|----------|----------|--|
| 1 | Cyanide | Distillation, Colorimetric Method ^[2] |
| 2 | pH | Electrometric Method ^[2] |
| 3 | Phenols | Distillation, Direct Photometric Method ^[2] |

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วิภา สันกุล

(นางสาววิชุดา สัมฤทธิ์ผล)

ผู้อำนวยการ

ศูนย์วิจัยและเตือนภัยมลพิษโรงงานภาคตะวันออก