

# **CERTIFICATE OF CALIBRATION**

## **FOR**

**NOMENCLATURE : ELECTRONIC BALANCE**  
**MANUFACTURER : METTLER TOLEDO**  
**MODEL / TYPE : AB204-S**  
**SERIAL NO. : 1123163290[MEC-LAB02]**  
**CLID. NO. : 362101622**  
**JOB CONTROL NO. : 230712075999**

**CUSTOMER : MINE ENGINEERING CONSULTANT CO., LTD.**

**DATE OF RECEIVED : 12 July 2023**

**DATE OF ISSUED : 31 July 2023**

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

**Calibrated By :**



**Approved By :**

**Authorized Signatory**

**31 July 2023**



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

**Certificate No. Q23075999**

**F3-011-04/01-12**

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## REPORT OF CALIBRATION

### FOR

**NOMENCLATURE** : **ELECTRONIC BALANCE**  
**MANUFACTURER** : **METTLER TOLEDO**  
**MODEL / TYPE** : **AB204-S**  
**SERIAL NO.** : **1123163290[MEC-LAB02]**  
**LOCATION SITE** : **LABORATORY**  
**DATE OF CALIBRATION** : **25 July 2023**

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#### ENVIRONMENT CONDITIONS :

**Temperature** : 25 °C to 26 °C **Relative Humidity** : 48 % to 50 %

#### PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPMB-01** based on **EURAMET/cg-18/Version 4.0 (11/2015)**.

The calibration was performed by Comparison with Weight Set which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Weight Set Mettler Toledo Class E2 S/N. 158850.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).

Certificate No. MM-0120-21, Due Date 17 December 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95%. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

**Certificate No. Q23075999**

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**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( ) without adjustment ( X ) adjustment**

## CALIBRATION DATA

### 1. Error of indications [ Before Adjustment ]

| Nominal Test Value<br>( g ) | Conventional mass<br>( g ) | Display Value<br>( g ) | Error of<br>Balance ( g ) | Uncertainty<br>$\pm$ ( mg ) | Coverage factor $k$ |
|-----------------------------|----------------------------|------------------------|---------------------------|-----------------------------|---------------------|
| 10.0000                     | 10.0000                    | 9.9999                 | -0.0001                   | -                           | -                   |
| 20.0000                     | 20.0000                    | 19.9997                | -0.0003                   | -                           | -                   |
| 50.0000                     | 50.0000                    | 49.9993                | -0.0007                   | -                           | -                   |
| 100.0000                    | 100.0000                   | 99.9989                | -0.0011                   | -                           | -                   |
| 200.0000                    | 199.9997                   | 199.9982               | -0.0015                   | -                           | -                   |

### 2. Error of indications [ After Adjustment ]

| Nominal Test Value<br>( g ) | Conventional mass<br>( g ) | Display Value<br>( g ) | Error of<br>Balance ( g ) | Uncertainty<br>$\pm$ ( mg ) | Coverage factor $k$ |
|-----------------------------|----------------------------|------------------------|---------------------------|-----------------------------|---------------------|
| Unload                      | 0.0000                     | 0.0000                 | 0.0000                    | 0.03                        | 2,28                |
| 0.0010                      | 0.0010                     | 0.0010                 | 0.0000                    | 0.06                        | 2,00                |
| 0.0100                      | 0.0100                     | 0.0100                 | 0.0000                    | 0.06                        | 2,00                |
| 0.1000                      | 0.1000                     | 0.1000                 | 0.0000                    | 0.06                        | 2,00                |
| 1.0000                      | 1.0000                     | 1.0000                 | 0.0000                    | 0.07                        | 2,00                |
| 5.0000                      | 5.0000                     | 5.0000                 | 0.0000                    | 0.07                        | 2,00                |
| 10.0000                     | 10.0000                    | 10.0000                | 0.0000                    | 0.07                        | 2,00                |
| 50.0000                     | 50.0000                    | 50.0000                | 0.0000                    | 0.08                        | 2,00                |
| 100.0000                    | 100.0000                   | 100.0000               | 0.0000                    | 0.12                        | 2,00                |
| 150.0000                    | 149.9999                   | 149.9999               | 0.0000                    | 0.24                        | 2,00                |
| 200.0000                    | 199.9997                   | 199.9997               | 0.0000                    | 0.24                        | 2,00                |

### 3. Repeatability of indications

| Nominal Test Value ( g ) | Standard Deviation of Reading ( g ) |
|--------------------------|-------------------------------------|
| 200.0000                 | 0.00004                             |

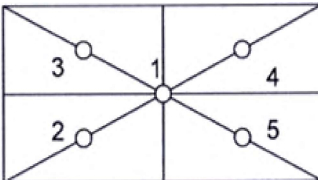
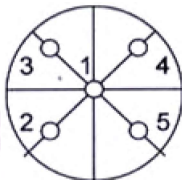
**Certificate No. Q23075999**

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## CALIBRATION DATA

### 4. Effect of eccentric application of a load on the indication

|  |  |  |  |            |            |                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------|------------|---------------------------------------------|
| Nominal Test Value ( g )                                                          | Display Value ( g )                                                               |                                                                                   |                                                                                     |            |            | Maximum Difference of<br>Center Value ( g ) |
|                                                                                   | Position 1                                                                        | Position 2                                                                        | Position 3                                                                          | Position 4 | Position 5 |                                             |
| 50.0000                                                                           | 50.0000                                                                           | 49.9999                                                                           | 50.0000                                                                             | 50.0000    | 50.0000    | 0.0001                                      |

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 41 of 54

**This report is valid for the above stated instrument/s only.**

### End of Certificate ###

Certificate No. Q23075999

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# Certificate of Calibration

**Calibration Certification Information**

Cal. Date: December 5, 2022      Rootsmeter S/N: 438320      Ta: 294 °K  
 Operator: Jim Tisch      Pa: 751.1 mm Hg  
 Calibration Model #: TE-5025A      Calibrator S/N: 2262

| Run | Vol. Init (m3) | Vol. Final (m3) | ΔVol. (m3) | ΔTime (min) | ΔP (mm Hg) | ΔH (in H2O) |
|-----|----------------|-----------------|------------|-------------|------------|-------------|
| 1   | 1              | 2               | 1          | 1.4280      | 3.2        | 2.00        |
| 2   | 3              | 4               | 1          | 1.0110      | 6.4        | 4.00        |
| 3   | 5              | 6               | 1          | 0.9000      | 7.9        | 5.00        |
| 4   | 7              | 8               | 1          | 0.8570      | 8.8        | 5.50        |
| 5   | 9              | 10              | 1          | 0.7080      | 12.8       | 8.00        |

**Data Tabulation**

| Vstd (m3)   | Qstd (x-axis) | $\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis) | Va        | Qa (x-axis) | $\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis) |
|-------------|---------------|------------------------------------------------------------------------------------------|-----------|-------------|---------------------------------------------------------|
| 0.9974      | 0.6985        | 1.4154                                                                                   | 0.9957    | 0.6973      | 0.8848                                                  |
| 0.9932      | 0.9824        | 2.0017                                                                                   | 0.9915    | 0.9807      | 1.2513                                                  |
| 0.9912      | 1.1013        | 2.2380                                                                                   | 0.9895    | 1.0994      | 1.3990                                                  |
| 0.9900      | 1.1552        | 2.3472                                                                                   | 0.9883    | 1.1532      | 1.4673                                                  |
| 0.9846      | 1.3907        | 2.8308                                                                                   | 0.9830    | 1.3884      | 1.7696                                                  |
| <b>QSTD</b> | m=            | <b>2.04196</b>                                                                           | <b>QA</b> | m=          | <b>1.27864</b>                                          |
|             | b=            | <b>-0.00930</b>                                                                          |           | b=          | <b>-0.00581</b>                                         |
|             | r=            | <b>0.99998</b>                                                                           |           | r=          | <b>0.99998</b>                                          |

**Calculations**

|                                                                                                                                    |                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <b>Vstd=</b> $\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$                                                                             | <b>Va=</b> $\Delta Vol((Pa-\Delta P)/Pa)$                                                       |
| <b>Qstd=</b> $Vstd/\Delta Time$                                                                                                    | <b>Qa=</b> $Va/\Delta Time$                                                                     |
| <b>For subsequent flow rate calculations:</b>                                                                                      |                                                                                                 |
| <b>Qstd=</b> $1/m \left( \left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} \right) - b \right)$ | <b>Qa=</b> $1/m \left( \left( \sqrt{\Delta H \left( \frac{Ta}{Pa} \right)} \right) - b \right)$ |

**Standard Conditions**

|            |                                       |
|------------|---------------------------------------|
| Tstd:      | 298.15 °K                             |
| Pstd:      | 760 mm Hg                             |
| <b>Key</b> |                                       |
| ΔH:        | calibrator manometer reading (in H2O) |
| ΔP:        | rootsmeter manometer reading (mm Hg)  |
| Ta:        | actual absolute temperature (°K)      |
| Pa:        | actual barometric pressure (mm Hg)    |
| b:         | intercept                             |
| m:         | slope                                 |

**RECALIBRATION**

US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

# Certificate of Calibrator

## for ST-120 Sound Calibrator

No. 20230323J139

Name of Product Sound Calibrator

Type ST-120

Serial Number ST120C0669E

Specification Class 1

Date 2023/07/07

Tested by



|                           |                             |
|---------------------------|-----------------------------|
| 1. Outside :              | <u>OK</u>                   |
| 2. Sound Pressure Level : | <u>93.96 dB ; 114.00 dB</u> |
| 3. Frequency :            | <u>1000.24 Hz</u>           |
| 4. Distortion :           | <u>1.1 % ; 1.2 %</u>        |

### Environment conditions :

|                     |              |            |
|---------------------|--------------|------------|
| Air temperature :   | <u>20</u>    | <u>°C</u>  |
| Relative humidity : | <u>50</u>    | <u>%</u>   |
| Static pressure :   | <u>101.8</u> | <u>kPa</u> |





## Certificate of Calibration

Certificate Number : SPR23010174-3

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Customer : MINE ENGINEERING CONSULTANT COMPANY LIMITED

Equipment Name : Vibration Monitors

Manufacturer : Instantel

Model : N/A

Serial Number : UM14539

ID. Number : VM-NO-8

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Received Date : 13 Jan 2023

Relative Humidity :  $50\% \pm 15\%$

Calibration Date : 17 Jan 2023

Location of Calibration : In-Lab

Recommend Due Date : 17 Jan 2024

Calibration Procedure : In-House Method

Date of Issue : 18 Jan 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :

Calibration Officer

Approved

Authorized Signatory



## Calibration Report

Certificate Number : SPR23010174-3

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### Reference Standards

| Equipment Name    | Model  | Serial No. | Certificate No. | Due. Date   |
|-------------------|--------|------------|-----------------|-------------|
| ICP Accelerometer | 353B04 | LW231796   | 45941           | 13 Nov 2022 |

### Traceability

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

PTB - Physikalisch Technische Bundesanstalt, Germany





## Result of Calibration

Certificate No. : SPR23010174-3

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Results of Calibration : (\*) Without ( ) After Adjustment

Geophone P/N 721A3301 Functional Performance Test

| Function        | STD Reading | UUC. Reading | Error  | Uncertainty<br>(±) |
|-----------------|-------------|--------------|--------|--------------------|
| Velocity (mm/s) | 5.004       | 4.991        | -0.013 | 0.059              |

Frequency Response Performance Test @ 5mm/s

Unit : m/s<sup>2</sup>

| Frequency<br>(Hz) | STD Reading | UUC. Reading | Error  | Uncertainty<br>(±) |
|-------------------|-------------|--------------|--------|--------------------|
| 10.0              | 5.010       | 4.988        | -0.022 | 0.058              |
| 20.0              | 5.008       | 4.986        | -0.022 | 0.058              |
| 50.0              | 5.007       | 4.990        | -0.017 | 0.058              |
| 80.0              | 5.005       | 4.987        | -0.018 | 0.058              |
| 100.0             | 5.005       | 4.989        | -0.016 | 0.058              |
| 160.0             | 5.003       | 4.992        | -0.011 | 0.058              |
| 200.0             | 5.005       | 4.990        | -0.015 | 0.058              |
| 500.0             | 5.007       | 4.991        | -0.016 | 0.058              |



## Result of Calibration

Certificate No. : SPR23010174-3

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Results of Calibration : (★) Without ( ) After Adjustment

Linearity Performance Test

Unit : m/s<sup>2</sup>

| Frequency<br>(Hz) | STD Reading | UUC. Reading | Error  | Uncertainty<br>(±) |
|-------------------|-------------|--------------|--------|--------------------|
| 160.0             | 0.501       | 0.495        | -0.006 | 0.0060             |
| 160.0             | 1.000       | 0.992        | -0.008 | 0.012              |
| 160.0             | 1.502       | 1.490        | -0.012 | 0.017              |
| 160.0             | 2.000       | 1.985        | -0.015 | 0.023              |
| 160.0             | 3.001       | 2.981        | -0.020 | 0.035              |
| 160.0             | 5.002       | 4.976        | -0.026 | 0.058              |
| 160.0             | 9.997       | 9.970        | -0.027 | 0.12               |

### Note:

The result of calibration was found accurate as show on date and place of calibration only.

This Certificate is not certified for any commercial transaction.

### Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2$ , providing a level of confidence approximately 95%

– End of Certificate –



# Calibration Certificate

Part Number: 721A2601

Description: Micromate with DIN Geophone

Serial Number: UM21810

Calibration Date: 'JUL 10 2023

Calibration Reference Equipment: 714J7402

*Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.*

*Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.*

*The environment in which this product was calibrated is maintained within the operating specifications of the instrument.*

*Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.*

Calibrated By: \_\_\_\_\_



309 Legget Drive, Ottawa, Ontario, K2K 3A3, (613) 592-4642

# **CERTIFICATE OF CALIBRATION**

## **FOR**

**NOMENCLATURE : ELECTRONIC BALANCE**  
**MANUFACTURER : SARTORIUS**  
**MODEL / TYPE : AZ214**  
**SERIAL NO. : 28092281[MEC-LAB01]**  
**CLID. NO. : 362101621**  
**JOB CONTROL NO. : 230712075998**

**CUSTOMER : MINE ENGINEERING CONSULTANT CO., LTD.**

**DATE OF RECEIVED : 12 July 2023**

**DATE OF ISSUED : 02 August 2023**

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

**Calibrated By :**

**Approved By :**

**Authorized Signatory**

**02 August 2023**



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units ( SI )

**Certificate No. Q23075998**

**F3-011-04/01-12**

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## REPORT OF CALIBRATION

### FOR

**NOMENCLATURE** : **ELECTRONIC BALANCE**  
**MANUFACTURER** : **SARTORIUS**  
**MODEL / TYPE** : **AZ214**  
**SERIAL NO.** : **28092281[MEC-LAB01]**  
**LOCATION SITE** : **LABORATORY**  
**DATE OF CALIBRATION** : **25 July 2023**

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#### ENVIRONMENT CONDITIONS :

Temperature : 25 °C to 26 °C

Relative Humidity : 48 % to 50 %

#### PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPMB-01** based on **EURAMET/cg-18/Version 4.0 (11/2015)**.

The calibration was performed by Comparison with Weight Set which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Weight Set, Mettler Toledo Class E2 S/N. 158850.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).

Certificate No. MM-0120-21, Due Date 17 December 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95%. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

**Certificate No. Q23075998**

**F3-011-04/01-12**

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**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( ) without adjustment ( X ) adjustment**

## CALIBRATION DATA

### 1. Error of indications [ Before Adjustment ]

| Nominal Test Value<br>( g ) | Conventional mass<br>( g ) | Display Value<br>( g ) | Error of<br>Balance ( g ) | Uncertainty<br>$\pm$ ( mg ) | Coverage factor $k$ |
|-----------------------------|----------------------------|------------------------|---------------------------|-----------------------------|---------------------|
| 10.0000                     | 10.0000                    | 10.0004                | +0.0004                   | -                           | -                   |
| 20.0000                     | 20.0000                    | 19.9998                | -0.0002                   | -                           | -                   |
| 50.0000                     | 50.0000                    | 49.9993                | -0.0007                   | -                           | -                   |
| 100.0000                    | 100.0000                   | 99.9989                | -0.0011                   | -                           | -                   |
| 200.0000                    | 199.9997                   | 199.9984               | -0.0013                   | -                           | -                   |

### 2. Error of indications [ After Adjustment ]

| Nominal Test Value<br>( g ) | Conventional mass<br>( g ) | Display Value<br>( g ) | Error of<br>Balance ( g ) | Uncertainty<br>$\pm$ ( mg ) | Coverage factor $k$ |
|-----------------------------|----------------------------|------------------------|---------------------------|-----------------------------|---------------------|
| Unload                      | 0.0000                     | 0.0000                 | 0.0000                    | 0.04                        | 2,32                |
| 0.0010                      | 0.0010                     | 0.0010                 | 0.0000                    | 0.07                        | 2,00                |
| 0.0100                      | 0.0100                     | 0.0100                 | 0.0000                    | 0.07                        | 2,00                |
| 0.1000                      | 0.1000                     | 0.1000                 | 0.0000                    | 0.07                        | 2,00                |
| 1.0000                      | 1.0000                     | 1.0000                 | 0.0000                    | 0.07                        | 2,00                |
| 5.0000                      | 5.0000                     | 4.9999                 | -0.0001                   | 0.07                        | 2,00                |
| 10.0000                     | 10.0000                    | 9.9999                 | -0.0001                   | 0.08                        | 2,00                |
| 50.0000                     | 50.0000                    | 49.9999                | -0.0001                   | 0.11                        | 2,00                |
| 100.0000                    | 100.0000                   | 99.9998                | -0.0002                   | 0.18                        | 2,00                |
| 150.0000                    | 149.9999                   | 149.9998               | -0.0001                   | 0.26                        | 2,00                |
| 200.0000                    | 199.9997                   | 199.9996               | -0.0001                   | 0.33                        | 2,00                |

### 3. Repeatability of indications

| Nominal Test Value ( g ) | Standard Deviation of Reading ( g ) |
|--------------------------|-------------------------------------|
| 200.0000                 | 0.00006                             |

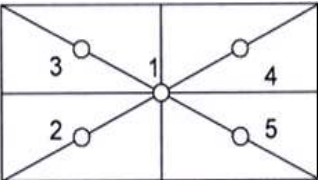
**Certificate No. Q23075998**

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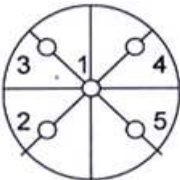
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## CALIBRATION DATA

### 4. Effect of eccentric application of a load on the indication



✓



| Nominal Test Value ( g ) | Display Value ( g ) |            |            |            |            | Maximum Difference of<br>Center Value ( g ) |
|--------------------------|---------------------|------------|------------|------------|------------|---------------------------------------------|
|                          | Position 1          | Position 2 | Position 3 | Position 4 | Position 5 |                                             |
| 50.0000                  | 49.9999             | 49.9997    | 49.9999    | 50.0000    | 49.9997    | 0.0002                                      |

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 41 of 54

**This report is valid for the above stated instrument/s only.**

### End of Certificate ###

Certificate No. Q23075998

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# **CERTIFICATE OF CALIBRATION**

## **FOR**

**NOMENCLATURE : pH METER**  
**MANUFACTURER : EUTECH INSTRUMENTS**  
**MODEL / TYPE : PH700**  
**SERIAL NO. : 983068/93X218814/93X052911[MEC-LAB06]**  
**CLID. NO. : 372200480**  
**JOB CONTROL NO. : 230725081582**

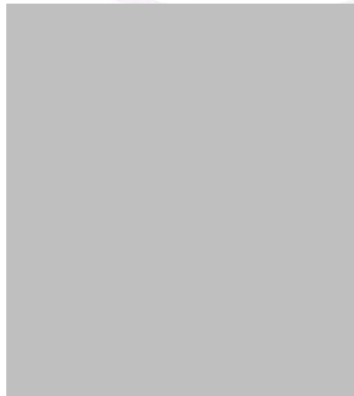
**CUSTOMER : MINE ENGINEERING CONSULTANT CO., LTD.**

**DATE OF RECEIVED : 25 July 2023**

**DATE OF ISSUED : 02 August 2023**

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

**Calibrated By :**



**Approved By :**

**Authorized Signatory**

**02 August 2023**



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

**Certificate No. Q23081582**

**F3-011-04/01-12**

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## REPORT OF CALIBRATION

### FOR

**NOMENCLATURE** : pH METER  
**MANUFACTURER** : EUTECH INSTRUMENTS  
**MODEL / TYPE** : PH700  
**SERIAL NO.** : 983068/93X218814/93X052911[MEC-LAB06]  
**LOCATION SITE** : LABORATORY  
**DATE OF CALIBRATION** : 25 July 2023

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#### ENVIRONMENT CONDITIONS :

Temperature : 24°C to 25°C

Relative Humidity : 48% to 52%

#### PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPCH-01, CLC-CPTH-03** based on **ASTM E 644-04** as calibration guidelines. The calibration was performed by direct measurement with Certified Reference Material (CRM) and comparison with Micro Calibration Bath, Precision Thermometer and IPRT which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

1. pH Standard Solution, NIMT TRM CODE TRM-S-2002 , TRM CODE TRM-S-2003 , TRM CODE TRM-S-2007.
2. pH Standard Solution, Control Company Catalog Number 06-664-260,11754256, Lot Number CC757348.
3. Precision Thermometer, ASL Model F100 S/N. 010228/28.
4. Micro Calibration Bath, Kambic Model OBM-LT S/N. 18015718.
5. IPRT, SDL Model T100-450-1D S/N. K0897A-1-19.

Certificate No. **Q23081582**

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## TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).  
Lot Number. 080822 , 040822 , 230822. Due Date 26 April 2024.
2. The measurements are traceable to International System of Units (SI) , through Control Company.  
Certificate No. 4281-13507707 , Due Date 14 July 2024.
3. The measurements are traceable to International System of Units (SI) , through Thailand Institute of Scientific and Technological Research (TISTR). Certificate No. PSL-T 0822/65, Due Date 22 August 2023.
4. The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd.  
Certificate No. Q22130793, Due Date 05 January 2024.
5. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).  
Certificate No. TT-0104-22, Due Date 25 August 2023.

## UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

**Certificate No. Q23081582**

**F3-011-04/01-12**

page 3 of 4



**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment**

The table in the following gives the calibration results and associated measurement uncertainties of pH meter.

## CALIBRATION DATA

### 1. pH METER RESULT @ 25 °C

| Standard pH<br>Buffer Solution<br>(pH) | pH Meter<br>Reading<br>(pH) | pH Meter<br>Reading<br>(mV) | Correction<br>(pH) | Uncertainty of<br>pH Measurement<br>( $\pm$ pH) | k Factor |
|----------------------------------------|-----------------------------|-----------------------------|--------------------|-------------------------------------------------|----------|
| 1.682                                  | 1.68                        | 280                         | +0.002             | 0.015                                           | 2,07     |
| 4.003                                  | 4.00                        | 150.0                       | +0.003             | 0.010                                           | 2,00     |
| 7.000                                  | 7.00                        | -25.3                       | 0.000              | 0.013                                           | 2,00     |
| 10.003                                 | 10.01                       | -193.2                      | -0.007             | 0.016                                           | 2,05     |

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 2,3 of 54

### 2. TEMPERATURE RESULT [ THERMISTOR ]

| Immersion depth (mm) | Actual Temperature (°C) | DUC Reading (°C) | Correction (°C) | Uncertainty $\pm$ (°C) |
|----------------------|-------------------------|------------------|-----------------|------------------------|
| 100                  | 25.00                   | 25.0             | 0.00            | 0.13                   |

Note. Probe  $\varnothing$  4 mm

Materials : Metal Sheath.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 47 of 54

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of  $k = 2,00$ .

**This report is valid for the above stated instrument/s only.**

**### End of Certificate ###**

**Certificate No. Q23081582**

**F3-011-04/01-12**

page 4 of 4

## CERTIFICATE OF CALIBRATION

### FOR

**NOMENCLATURE** : OVEN  
**MANUFACTURER** : MEMMERT  
**MODEL / TYPE** : UF110  
**SERIAL NO.** : B418.1125[MEC-LAB05]  
**CLID. NO.** : 332102410  
**JOB CONTROL NO.** : 230712076000

**CUSTOMER** : MINE ENGINEERING CONSULTANT CO., LTD.

**DATE OF RECEIVED** : 12 July 2023

**DATE OF ISSUED** : 02 August 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

**Calibrated By :**

**Approved By :**

Authorized Signatory

02 August 2023



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

**Certificate No. Q23076000**

**F3-011-04/01-12**

page 1 of 4

## REPORT OF CALIBRATION

### FOR

**NOMENCLATURE** : OVEN  
**MANUFACTURER** : MEMMERT  
**MODEL / TYPE** : UF110  
**SERIAL NO.** : B418.1125[MEC-LAB05]  
**LOCATION SITE** : LABORATORY  
**DATE OF CALIBRATION** : 25 July 2023

---

#### ENVIRONMENT CONDITIONS :

Temperature : 27 °C to 28 °C

Relative Humidity : 52% to 53 %

#### PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPH-07** based on **TLAS G-20** as calibration guidelines.

The calibration was performed by using Hydra Series II which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Hydra Series II, Fluke Model 2635A S/N. 8209003.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd.

Certificate No. Q23065867, Due Date 22 June 2024.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

**Certificate No. Q23076000**

**F3-011-04/01-12**

page 2 of 4

**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment**

The table in the following gives the calibration results and associated measurement uncertainties of the measuring oven.

## CALIBRATION DATA

### 1. OVEN PERFORMANCE

| DUC            |                   | Measured Uniformity | Measured Stability | Measured Overall |
|----------------|-------------------|---------------------|--------------------|------------------|
| Setting ( °C ) | Indicating ( °C ) | ( °C )              | ( °C )             | Variation ( °C ) |
| 85.0           | 85.0              | 0.50                | 0.26               | 1.30             |
| 104.0          | 104.0             | 0.61                | 0.11               | 1.03             |
| 180.0          | 180.0             | 1.04                | 0.13               | 1.90             |

**Certificate No. Q23076000**

**F3-011-04/01-12**

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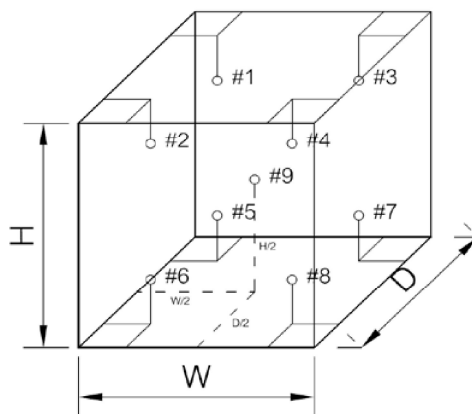
## CALIBRATION DATA

### 2. TEMPERATURE DISTRIBUTION

| DUC            |                   | Measured Temperature ( °C )@Probe No.9 is Ref. |        |        |        |        |        |        |        |        | Uncertainty<br>$\pm$ ( °C ) | Coverage<br>factor $k$ |
|----------------|-------------------|------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------------------|------------------------|
| Setting ( °C ) | Indicating ( °C ) | 1                                              | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |                             |                        |
| 85.0           | 85.0              | 85.09                                          | 85.44  | 85.15  | 85.34  | 85.12  | 85.13  | 84.65  | 85.36  | 85.08  | 0.39                        | 2,00                   |
| 104.0          | 104.0             | 104.08                                         | 104.32 | 104.19 | 104.42 | 104.11 | 104.16 | 103.55 | 104.27 | 104.08 | 0.45                        | 2,00                   |
| 180.0          | 180.0             | 180.34                                         | 181.19 | 180.60 | 181.00 | 180.23 | 180.47 | 179.46 | 181.10 | 180.21 | 0.49                        | 2,00                   |

Technical Note : W = 56 cm, D = 40 cm, H = 48 cm.

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This report is valid for the above stated instrument/s only.

### End of Certificate ###

Certificate No. Q23076000

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Certificate No. C07230015

## Calibration Certificate

Represent to Calibration Certificate, Serial number C07230011

**Equipment:** SPECTROPHOTOMETER

Model: 723C

Serial No.(or ID): 2C41301043 (MEC-LAB11)

Manufacturer: KWF

Condition: In Condition

Job No.: KSMT2300233

Received Date: 24 July 2023

Issued Date: 09 August 2023

Page: 1 of 3

### Customer

MINE ENGINEERING CONSULTANT CO.,LTD.

### Calibration Place

MINE ENGINEERING CONSULTANT CO.,LTD.(Laboratory)

### Calibration Date

24 July 2023

### Environment Condition

Temperature: 22.1 °C ± 0.8 °C

Humidity: 52.4 %RH ± 4.9 %RH

### The Method used

In-house method, WI07, based 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. 108691 and 108692

The standard for Photometric Certificate No. 109010

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 SCIMET Co., Ltd.



Person in charge



Authorized signatory

### Calibration Results:

#### Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 4 nm and UUC at 4 nm

| Standard Wavelength<br>(nm) | Unit Under Calibration<br>(nm) | Correction<br>(nm) | Uncertainty of<br>Measurement ( ± nm) |
|-----------------------------|--------------------------------|--------------------|---------------------------------------|
| 417.67                      | 417.6                          | 0.07               | 0.14                                  |
| 440.74                      | 440.8                          | -0.06              | 0.14                                  |
| 448.99                      | 448.8                          | 0.19               | 0.14                                  |
| 472.22                      | 472.2                          | 0.02               | 0.14                                  |
| 513.70                      | 513.7                          | 0.00               | 0.14                                  |
| 537.49                      | 537.4                          | 0.09               | 0.14                                  |
| 574.60                      | 574.7                          | -0.10              | 0.14                                  |
| 641.76                      | 641.8                          | -0.04              | 0.14                                  |
| 684.63                      | 684.7                          | -0.07              | 0.14                                  |
| 740.27                      | 740.4                          | -0.13              | 0.14                                  |
| 748.28                      | 748.4                          | -0.12              | 0.14                                  |
| 807.16                      | 807.3                          | -0.14              | 0.14                                  |
| 879.70                      | 879.8                          | -0.10              | 0.14                                  |

### Calibration Results:

#### Without Adjustment

##### Photometric Accuracy (Absorbance)

| Wavelength | Standard absorbance<br>(Abs) | Unit Under Calibration<br>(Abs) | Correction<br>(Abs) | Uncertainty of<br>Measurement( $\pm$ Abs) |
|------------|------------------------------|---------------------------------|---------------------|-------------------------------------------|
| 420 nm     | 0.0000                       | 0.000                           | 0.0000              | 0.0045                                    |
|            | 0.5617                       | 0.562                           | -0.0003             | 0.0045                                    |
|            | 0.7392                       | 0.738                           | 0.0012              | 0.0045                                    |
|            | 1.0550                       | 1.055                           | 0.0000              | 0.0045                                    |
| 440 nm     | 0.0000                       | 0.000                           | 0.0000              | 0.0045                                    |
|            | 0.5513                       | 0.552                           | -0.0007             | 0.0045                                    |
|            | 0.7230                       | 0.722                           | 0.0010              | 0.0045                                    |
|            | 1.0324                       | 1.033                           | -0.0006             | 0.0045                                    |
| 465 nm     | 0.0000                       | 0.000                           | 0.0000              | 0.0045                                    |
|            | 0.5036                       | 0.506                           | -0.0024             | 0.0045                                    |
|            | 0.6735                       | 0.672                           | 0.0015              | 0.0045                                    |
|            | 0.9615                       | 0.963                           | -0.0015             | 0.0045                                    |
| 546.1 nm   | 0.0000                       | 0.000                           | 0.0000              | 0.0045                                    |
|            | 0.5176                       | 0.519                           | -0.0014             | 0.0045                                    |
|            | 0.6930                       | 0.692                           | 0.0010              | 0.0045                                    |
|            | 0.9908                       | 0.992                           | -0.0012             | 0.0045                                    |
| 590 nm     | 0.0000                       | 0.000                           | 0.0000              | 0.0045                                    |
|            | 0.5530                       | 0.554                           | -0.0010             | 0.0045                                    |
|            | 0.7196                       | 0.718                           | 0.0016              | 0.0045                                    |
|            | 1.0301                       | 1.030                           | 0.0001              | 0.0045                                    |
| 635 nm     | 0.0000                       | 0.000                           | 0.0000              | 0.0045                                    |
|            | 0.5370                       | 0.538                           | -0.0010             | 0.0045                                    |
|            | 0.6862                       | 0.686                           | 0.0002              | 0.0045                                    |
|            | 0.9822                       | 0.982                           | 0.0002              | 0.0045                                    |

The End of Certificate



**Statements of conformity:**

This conformity certificate documents the validity of the following statements of conformity based on the measurement results of corresponding calibration certificate:

The error of temperature determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, ASTM E 275-08 and ASTM E 387-04. Therefore, those parameters have not been assessed separately.

**Tolerance and Decision rules:**

Assessment of the conformity of the measurement device are done based on direct comparison of the relevant measurement results with the tolerances and decision rule are prescribed by the customer.

**Decision rule :** ☐ Choice A Binary Statement for Simple Acceptance Rule ( $w = 0$ ), Specific Risk < 50% PFA.

☒ Choice B Non-binary statement with guard band ( $w = 1 U$ ), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.

☐ Choice C Customer defined, Customers may define arbitrary multiple of  $r$  to have applied as guard band ( $w = r U$ ).

; PFA – Probability of False Accept



Authorized signatory

### Without Adjustment

#### Wavelength Accuracy (nm), The spectral bandwidth of Std at 4 nm and UUC at 4 nm

| Unit Under Calibration | Correction | Guard Band (w) | Tolerance ( $\pm$ ) | Conformity |
|------------------------|------------|----------------|---------------------|------------|
| 417.6                  | 0.07       | 0.14           | 1.0                 | Pass       |
| 440.8                  | -0.06      | 0.14           | 1.0                 | Pass       |
| 448.8                  | 0.19       | 0.14           | 1.0                 | Pass       |
| 472.2                  | 0.02       | 0.14           | 1.0                 | Pass       |
| 513.7                  | 0.00       | 0.14           | 1.0                 | Pass       |
| 537.4                  | 0.09       | 0.14           | 1.0                 | Pass       |
| 574.7                  | -0.10      | 0.14           | 1.0                 | Pass       |
| 641.8                  | -0.04      | 0.14           | 1.0                 | Pass       |
| 684.7                  | -0.07      | 0.14           | 1.0                 | Pass       |
| 740.4                  | -0.13      | 0.14           | 1.0                 | Pass       |
| 748.4                  | -0.12      | 0.14           | 1.0                 | Pass       |
| 807.3                  | -0.14      | 0.14           | 1.0                 | Pass       |
| 879.8                  | -0.10      | 0.14           | 1.0                 | Pass       |

**Without Adjustment**
**Photometric Accuracy (Absorbance)**

| Wavelength | Unit Under Calibration | Correction | Guard Band (w) | Tolerance ( $\pm$ ) | Conformity |
|------------|------------------------|------------|----------------|---------------------|------------|
| 420 nm     | 0.000                  | 0.0000     | 0.0045         | 0.010               | Pass       |
|            | 0.562                  | -0.0003    | 0.0045         | 0.010               | Pass       |
|            | 0.738                  | 0.0012     | 0.0045         | 0.010               | Pass       |
|            | 1.055                  | 0.0000     | 0.0045         | 0.010               | Pass       |
| 440 nm     | 0.000                  | 0.0000     | 0.0045         | 0.010               | Pass       |
|            | 0.552                  | -0.0007    | 0.0045         | 0.010               | Pass       |
|            | 0.722                  | 0.0010     | 0.0045         | 0.010               | Pass       |
|            | 1.033                  | -0.0006    | 0.0045         | 0.010               | Pass       |
| 465 nm     | 0.000                  | 0.0000     | 0.0045         | 0.010               | Pass       |
|            | 0.506                  | -0.0024    | 0.0045         | 0.010               | Pass       |
|            | 0.672                  | 0.0015     | 0.0045         | 0.010               | Pass       |
|            | 0.963                  | -0.0015    | 0.0045         | 0.010               | Pass       |
| 546.1 nm   | 0.000                  | 0.0000     | 0.0045         | 0.010               | Pass       |
|            | 0.519                  | -0.0014    | 0.0045         | 0.010               | Pass       |
|            | 0.692                  | 0.0010     | 0.0045         | 0.010               | Pass       |
|            | 0.992                  | -0.0012    | 0.0045         | 0.010               | Pass       |
| 590 nm     | 0.000                  | 0.0000     | 0.0045         | 0.010               | Pass       |
|            | 0.554                  | -0.0010    | 0.0045         | 0.010               | Pass       |
|            | 0.718                  | 0.0016     | 0.0045         | 0.010               | Pass       |
|            | 1.030                  | 0.0001     | 0.0045         | 0.010               | Pass       |
| 635 nm     | 0.000                  | 0.0000     | 0.0045         | 0.010               | Pass       |
|            | 0.538                  | -0.0010    | 0.0045         | 0.010               | Pass       |
|            | 0.686                  | 0.0002     | 0.0045         | 0.010               | Pass       |
|            | 0.982                  | 0.0002     | 0.0045         | 0.010               | Pass       |

The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

**The End of Statements of Conformity**

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSMT2300233

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: 723C

หมายเลขเครื่อง: 2C41301043

| ตรวจสอบ (รับ)                       |                          | รายการตรวจเช็ค                                    | ตรวจสอบ (ส่ง)                       |                          | หมายเหตุ |
|-------------------------------------|--------------------------|---------------------------------------------------|-------------------------------------|--------------------------|----------|
| 24 Jul 2023                         |                          |                                                   | 24 Jul 2023                         |                          |          |
| ปกติ                                | ไม่ปกติ                  |                                                   | ปกติ                                | ไม่ปกติ                  |          |
|                                     |                          |                                                   |                                     |                          |          |
| <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. สวิทช์ 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 type="checkbox"/>            | <input type="checkbox"/> |          |
| <input type="checkbox"/>            | <input type="checkbox"/> | 6. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)  | <input type="checkbox"/>            | <input type="checkbox"/> | -        |
| <input type="checkbox"/>            | <input type="checkbox"/> | 7. ความยาวคลื่น (Wavelength Check)                | <input type="checkbox"/>            | <input type="checkbox"/> | -        |
| <input type="checkbox"/>            | <input type="checkbox"/> | 8. แหล่งกำเนิดแสง (UV < 3,000 hour)               | <input type="checkbox"/>            | <input type="checkbox"/> | -        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9. แหล่งกำเนิดแสง (Visible < 5,000 hour)          | <input checked="" type="checkbox"/> | <input type="checkbox"/> |          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 10. ช่องวัดหลายตัวอย่าง (Carousel Module)         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |          |

เพิ่มเติม/ข้อแนะนำ :

Service Engineer



# Avio200 Preventive Maintenance Report

Company Name: Mine Engineering Consultance CO., Ltd.

Instrument Location

Thanyaburi District, Pathum Thani.

Instrument Serial No.: 079S18071903

Date: 10-Aug-2023

## ICP-OES/Avio200 Preventive Maintenance (PM)

|                                              |                                        |                                            |             |
|----------------------------------------------|----------------------------------------|--------------------------------------------|-------------|
| <b>Company Name:</b>                         | Mine Engineering Consultance CO., Ltd. |                                            |             |
| <b>Address<br/>(Instrument Location):</b>    |                                        |                                            |             |
| <b>Serial Number:</b>                        | 079S18071903                           | <b>PM Number:</b>                          | 2 of 2      |
| <b>Customer Name<br/>(if applicable):</b>    |                                        | <b>Telephone Number:</b>                   |             |
| <b>Service Engineer<br/>Name:</b>            |                                        | <b>Service Order<br/>Number:</b>           | WO-02409453 |
| <b>Date PM Performed:<br/>(DD-MMM-YYYY)</b>  | 10-Aug-2023                            | <b>Next PM Due Date:<br/>(DD-MMM-YYYY)</b> | 10-Feb-2024 |
| <b>Standard Labor Hours to Complete PM :</b> |                                        | <b>4 hours</b>                             |             |

| Part Number    | Release | Publication Date |  |
|----------------|---------|------------------|-------------------------------------------------------------------------------------|
| 09370140 Rev.5 | B       | January 2018     |                                                                                     |

### Scope

The purpose of this PM is to ensure the continued functionality of the PerkinElmer/Avio200 by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

### General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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## Component List

| Component / Specific Model | Serial #     | Configuration Notes    |
|----------------------------|--------------|------------------------|
| Avio200                    | 079S18071903 | Syngistix V 3.0.0.3081 |
|                            |              |                        |

## Parts Lists

| Parts Included with the PM     |                                      |                |
|--------------------------------|--------------------------------------|----------------|
| Part Number<br>(if applicable) | Description                          | Quantity       |
| 09995098                       | Air Filter-Spectrometer              | Not Applicable |
| N077520                        | Air Filter-RF Generator              | Not Applicable |
| 09992731                       | Axial Window                         | Not Applicable |
| B0810377                       | Radial Window                        | Not Applicable |
| N0770438                       | O-ring kit, injector support adapter | Not Applicable |
| N0780437                       | O-ring kit, torch                    | Not Applicable |

| Additional Reagents and Standards Required for PM |                                                     |          |             |                             |
|---------------------------------------------------|-----------------------------------------------------|----------|-------------|-----------------------------|
| Part Number<br>(if applicable)                    | Description                                         | Quantity | Batch/Lot # | Expiration Date:<br>(MM/YY) |
| N0691579                                          | Multi-Element Standard<br>(N069-1579 diluted 10X)   | 1        | 7-263MFX1   | Apr-2024                    |
| N9300221                                          | Instrument Calibration-4<br>(N9300221 diluted 100X) | 1        | 59-091CRY1  | Jun-2024                    |

# Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

## 1. General:

- ✓ Ask customer about unit's performance since last visit.
- ✓ Check incoming AC line voltage under load for proper levels and grounding.
- ✓ Is the instrument operational?

## 2. Mechanical:

- ✓ Inspect and clean all fans and filters.
- ✓ Inspect and replace torch components and necessary.

Torch Components Replaced: ☐ Yes ☒ No

If yes, list components replaced:

- ✓ Inspect all tubing for signs of cracking or leaking and replace as necessary.

Tubing Replaced: ☐ Yes ☒ No

If yes, list tubing replaced:

- ✓ Inspect the peristaltic pump for proper operation.
- ✓ Check and adjust if necessary, the external nitrogen, argon shear gas and water supply pressures.
- ✓ Check and adjust if necessary, the internal nitrogen, main argon, torch argon and shear gas pressures

| Regulator   | Measured Pressure | Set Pressure               |
|-------------|-------------------|----------------------------|
| Nitrogen    | N/A               | NA (calibrated in Factory) |
| Main Argon  | 76                | 76psig                     |
| Torch Argon | 67                | 67psig                     |
| Shear Gas   | 65                | 65psig                     |
| Water       | 35                | 35psi                      |

- ✓ Check the shear gas nozzle for blockages and proper, uniform flow.
- ✓ Inspect nitrogen Hi/Low purge and shear gas solenoids for proper function.
- ✓ Inspect the function of all spectrometer motors. Drive the motors from the Spectrometer DCM. Check all motors, couplings, set screws, gears or drive assembly located on the spectrometer (prism/grating wavelength drives, slits, shutter, DV mirror, X/Y mirror) if problems are found.
- ✓ Perform preventative maintenance on the chiller as required. Make the customer aware of the importance of maintaining the chiller fluid level and filter replacement.
- ✓ Drain air compressor surge tank.
- ✓ Clean exterior of instrument.

### 3. Electrical:

- ☒ Visually inspect all PC boards for cleanliness and signs of corrosion.
  - ☒ Check all RF generator and spectrometer power supply voltages.
  - ☒ Run instrument diagnostic checks from the appropriate Device Control Module.

#### **RF Generator:**

- ☒ Check the RF generator status screens.
- ☒ Check the function of all interlocks.

#### **Spectrometer:**

- ☒ Check the spectrometer status screens.
- ☒ Check for proper function of all motors from the Motor Control window.

### 4. Optical:

- ☒ Check the neon lamp for proper operation.
- ☒ Ensure that neon initialization passes at power up.
- ☒ Ensure that there is a single, well defined peak of sufficient intensity (approximately 15,000 to 60,000 cts.) for the 703.241nm neon line viewed in the DCM Collect Spectra window. Re-generate the neon correction table if problems are encountered. If problems are still exhibited after the table is re-generated, replace the neon lamp assembly.

Neon Lamp Replaced: ☐ Yes ☒ No

- ☒ Perform the Initialize Optics routine from the Spectrometer Control window.
- ☒ Insure that the routine passes with no error codes. If it fails, run a manual prism scan from the spectrometer DCM.
- ☒ Insure the Dark Current measurement (Detector Calibration) passes at initialization.
- ☒ Check the shutter home sensor position.
- ☒ Check prism/electronics temperature sensor readback values from the DCM. It is normal for these readings to be shown in red. A typical prism temperature is approximately 29.5 degree C. A typical electronics temperature is approximately 35 degree C.
- ☒ Check the detector temperature from the DCM for -7.0 to -8.5 degree C. If outside of this range the detector cooling fan may not be operational. Further inspection may be necessary.
- ☒ Inspect for proper function of the transfer optics. 1) shutter 2) DV mirror 3) X/Y mirror.
- ☒ Clean or replace the axial and radial view windows as necessary.

Axial Window Replaced: ☐ Yes ☒ No

Radial Window Replaced: ☐ Yes ☒ No

### 5. Post PM Performance Tests:

- ☒ Perform View Align.

#### **5.1 Spectral Resolution:**

- ☒ Measure the spectrometers ability to separate two adjacent wavelengths.

| Parameter               | Specification | Test Result | Pass/Fail |
|-------------------------|---------------|-------------|-----------|
| As 193.696 - Resolution | ≤0.009        | 0.007       | Passed    |
| Ni 231.604 - Resolution | ≤0.011        | 0.008       | Passed    |
| Ni 341.476 - Resolution | ≤0.015        | 0.012       | Passed    |
| Ba 455.403 - Resolution | ≤0.020        | 0.017       | Passed    |



### 5.2 Precision:

- ☒ Test for reproducibility of a set of measurement.

| Parameter  | Specification   | Test Result | Pass/Fail |
|------------|-----------------|-------------|-----------|
| Zn 213.856 | %RSD $\leq$ 1 % | 0.42        | Passed    |
| Mg 280.856 | %RSD $\leq$ 1 % | 0.45        | Passed    |
| Mg 285.207 | %RSD $\leq$ 1 % | 0.29        | Passed    |
| Ba 455.403 | %RSD $\leq$ 1 % | 0.26        | Passed    |

### 5.4 Mn BEC:

- ☒ Run Axial and Radial BEC according to the A&T spec, or the commissioning test procedure.

### Mn Background Equivalent Concentration:

Method "MnBEC" For Samples "IB (2% $\text{HNO}_3$ )" and "IS (N069-1579/10)", record intensities.

Calculated BEC:  $\text{BEC} = (\text{IB} * \text{Conc of Std}) / (\text{IS} - \text{IB})$ . Where Conc of Std = 1,000 PPB

| Element    | Mode     | Conc.     | IB     | IS        |           |
|------------|----------|-----------|--------|-----------|-----------|
| Mn 257.610 | Radial   | 1,000 ppb | 7588.2 | 876421.1  |           |
| Mn 257.610 | Axial    | 1,000 ppb | 18796  | 2472751.8 |           |
|            |          |           |        |           |           |
| Mn 257.610 | IB*Conc. | IS - IB   | BEC    | Spec      | Pass/Fail |
| Radial     | 7588200  | 868832.9  | 8.71   | <30 PPB   | Passed    |
| Axial      | 18796000 | 2453955.8 | 7.65   | <30 PPB   | Passed    |

### 6. Review:

- ☒ Review with the customer PM work performed.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

### Additional Comments

### Additional Comments Regarding the PM

## Review

***The preventive maintenance checks and if applicable performance tests for ICP-OES/Avio200 have been completed.***

***This ICP-OES/Avio200 Passes ☒ Fails ☐ the preventive maintenance.***

### Review of Preventive Maintenance:

Authorized PerkinElmer F

Date:

10-Aug-2023

(DD-MMM-YYYY)

Authorized Customer Rep

Date:

10-Aug-2023

(DD-MMM-YYYY)

# PerkinElmer TruQ

Atomic Spectroscopy Standard



## Certificate of Analysis

**PerkinElmer Number:** N9300221

**Description:** Instrument Calibration Standard 4

**Matrix:** 5% HNO<sub>3</sub>

**Lot Number:** 59-091CRY1

**Certification Date:** DEC - - 2022

**Expiration Date:** JUN 30 2024

### \* Instrumental Analysis using ICP Spectrometer:

| Analyte | Labeled    | Measured   | SRM    | Analyte | Labeled    | Measured   | SRM   |
|---------|------------|------------|--------|---------|------------|------------|-------|
| As      | 100 µg/mL  | 100 µg/mL  | 3103a* | Pb      | 50.0 µg/mL | 49.8 µg/mL | 3128* |
| Tl      | 100 µg/mL  | 100 µg/mL  | 3158*  | Se      | 50.0 µg/mL | 50.1 µg/mL | 3149* |
| Cd      | 50.0 µg/mL | 50.0 µg/mL | 3108*  |         |            |            |       |

\* - indicates NIST SRM

† - indicates CRM (when NIST SRM is not available)

Reference Multi: Lot# 54-134CR, 57-156CR, 58-169CR

Refer to side 2 for details of certification.

Balances are calibrated with weight sets traceable to NIST.

We guarantee that our PerkinElmer TruQ Atomic Spectroscopy Standards are stable and accurate to ±0.5% of certified concentration until the expiration date, provided the standards are kept tightly capped and stored under normal laboratory conditions. This value is the sum of cumulative errors associated with the analytical determinations, pipetting, and diluting to final volume. For these solutions we use high purity acids, ASTM Type I water (18 megohm double deionized), and leached, triple-rinsed bottles. All glassware used is class A.

Certifying Officer:



**PerkinElmer, Inc.**

**U.S.A. Tel: 1-203-925-4600**

**U.S.A. Toll Free: 1-800-762-4000**

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-66/0021-02

MTC.No.23-66/0021-02

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## CALIBRATION CERTIFICATE

**Nomenclature : DRYCAL DC-LITE FLOWMETER**

Manufacturer : Bios International Corporation, USA

Serial No.: 8848

Model : DCL-ML

Scale range : 50 ml/min to 2 l/min

Subdivision : 0.1 ml/min

**Submitted by : MINE CONSULTANT CO.,LTD.**

**Received date :** 6 January 2023

**Condition of measured item :** Normal

**Calibration date :** 14 January 2023

**Standard :**

| Standard                           | Certificate No. | Date due  | Traceability |
|------------------------------------|-----------------|-----------|--------------|
| RTD Thermometer                    | PSL-T 336/63    | 6-Apr-23  | TISTR        |
| Molbox/PressureTransducer/UpStream | MP-0013-21      | 25-Jan-23 | NIMT         |
| Primary Flow Calibrator S/N 117982 | MW-0011-21      | 8-Apr-23  | NIMT         |

**Calibrated by :**

**Approved by :**

Director

**Mechanical Engineering Standards Laboratory**

Ref. 2013265010600036002

Issued Date 14 January 2023

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

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FM.BL.MTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-66/0021-02

2/2

MTC.No.23-66/0021-02

**Calibration point :** (100, 200, 300, 400, 500) ml/min

**Ambient condition :** Temperature (  $23 \pm 3$  ) °C , Relative humidity (  $55 \pm 15$  ) %

Atmospheric pressure (  $1010 \pm 13$  ) hPa

**Calibration method :** The flowmeter (UUC) was calibrated by comparison method with standard flowmeter according to CP-370.01.

The reported value is the value that converted to value at reference condition within pressure and temperature of the actual gas entering the UUC

**Measurement data :**

| UUC Value<br>(ml/min) | Standard Value<br>(ml/min) | Temperature<br>(°C) | Pressure<br>(hPa) | Deviation<br>(%) | Uncertainty<br>(%) |
|-----------------------|----------------------------|---------------------|-------------------|------------------|--------------------|
| 100.9                 | 100.93                     | 24.743              | 1010.23           | -0.03            | 1.02               |
| 199.7                 | 199.25                     | 24.772              | 1010.28           | +0.23            | 0.99               |
| 301.3                 | 300.62                     | 24.764              | 1010.34           | +0.21            | 0.99               |
| 402.2                 | 400.84                     | 24.785              | 1010.40           | +0.34            | 0.99               |
| 504.0                 | 502.25                     | 24.801              | 1009.42           | +0.34            | 0.99               |

The reported expanded uncertainties are based on standard uncertainties multiplied by a coverage factor  $k=2$ , which provides a level of confidence of approximately 95%.

The end of calibration certificate.

*M.*

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

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EM-BL-MTC-002 Rev.4