

# เอกสารแนบ 6

เอกสารสอบเทียบเครื่องมือ  
ที่ใช้ในการวิเคราะห์



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



NSC-TSI-TS17025  
CALIBRATION 3008

Cert. No.: 23CHO4  
Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : WTW  
Model : InoLab pH 730  
Serial No. : 10510388  
ID No. : ERTC-L-In.-049  
Condition As-Received: Used Item  
Received Date : 04 January 2023  
Calibration Date : 05 January 2023  
Reference : 2301-0002ON-15  
Submitted by : Environment Research & Technology Company Limited.  
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,  
Tongsohong, Laksi, Bangkok 10210

Calibration Place : ห้องปฏิบัติการ BOD (501)  
Ambient Temperature : (24.6 - 24.8) °C  
Relative Humidity : (50.8 - 51.1) %  
Calibration Procedure : In - house method :  
- CP-QCH2 by direct measurement with standard  
voltage calibrator and direct measurement  
with certified reference material (CRM)

Calibrated by : Krisda Malee

Approved by :  
(✓) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lengagatrakul

Issue Date : 17 January 2023

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.



Cert. No.: 23CHO4  
Page.: 2 of 2

### Condition of this calibration result

1. Reference Standard Instrument : -  
Instrument Serial No. ID No. Cert. No. Due Date  
1) Document Process Calibrator 43160066 130RC092 22E1223 13 Apr 2023  
2) Digital Thermometer 130RC018 22T778 20 Apr 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  
Buffer Solution Manufacturer Lot No. Exp. date  
pH 4.008 CPA chem 826588 09 July 2024  
pH 6.987 CPA chem 823322 20 June 2023  
pH 10.008 CPA chem 826590 09 July 2023

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

### Calibration Results

Function : mV Measurement

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

| Unit Under Calibration     | Nominal Value | Standard Voltage Input | Actual Reading |        | Uncertainty of Measurement (±mV) | Coverage factor k |
|----------------------------|---------------|------------------------|----------------|--------|----------------------------------|-------------------|
|                            |               |                        | mV             | pH     |                                  |                   |
| pH Meter<br>S/N.: 10510388 | pH 4.000      | 177.48                 | 177.5          | 4.000  | 0.058                            | 2.00              |
|                            | pH 7.000      | 0.00                   | 0.0            | 7.000  | 0.058                            | 2.00              |
|                            | pH 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 Buffer Solution | Actual pH Reading | Actual mV Reading |        | Uncertainty of pH measurement (±) | Coverage factor k |
|----------------------------------|--------------------------|-------------------|-------------------|--------|-----------------------------------|-------------------|
|                                  |                          |                   | mV                | pH     |                                   |                   |
| pH Electrode<br>S/N.: C211621046 | 4.008                    | 4.007             | 174.0             | 4.000  | 0.0049                            | 2.00              |
|                                  | 6.987                    | 6.987             | 3.8               | 7.000  | 0.0097                            | 2.00              |
|                                  | 10.008                   | 10.010            | -166.0            | 10.000 | 0.015                             | 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 %.

-000-



Inctech Metrological Center Co.,Ltd.  
39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,  
Saimai, Bangkok 10220, Thailand  
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



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## Certificate of Calibration

Certificate No. : MT23-7846  
Page : 1 of 2

Customer : Environment Research & Technology Co., Ltd.  
Address : 25/114 Moo 6 Soi Chinaketh1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210

Description : Incubator  
Manufacturer : Accuplus  
Model : Smart i250  
Serial No. : 2059-0218-0002  
Identification No. : ERTC-L-IN-143  
Calibration Place : Customer Laboratory

Order No. : 3938/23  
Received date : Dec 12, 2023  
Calibration date : Dec 12, 2023  
Environment Condition :  
Temperature : ( 25 $\pm$ 1.0 ) °C  
Humidity : ( 50 $\pm$ 30 ) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MT-006 According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

### Reference Standard Instruments :

| Instrument                                   | Model  | Serial No. | Certificate No. | Due Date     |
|----------------------------------------------|--------|------------|-----------------|--------------|
| LXI Data Acquisition Switch Unit with Sensor | 34972A | MY57003222 | MT23-5938       | Oct 05, 2024 |

This result of calibration was found accurate as shown on date and place of calibration only.

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand ( NIMT )

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor  $k = 2$ , providing a level of confidence of not less than 95%

Calibrated by :  
Issue date :

Approved by

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Rev 02 / Mar 2020

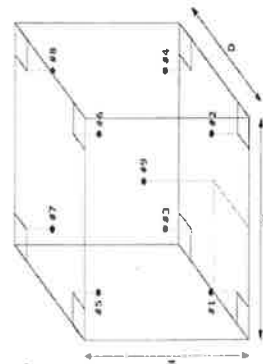
FM-MT-013

Certificate No. : MT23-7846  
Page : 2 of 2

Function : Temperature measurement  
Calibration point : 20 °C  
Result : Without adjustment  
Resolution : 0.1 °C

| Calibration point (°C) | Temperature of UUC* at each position (°C) |        |        |        |        |        |        |        |        | Uncertainty of measurement (+/- °C) |
|------------------------|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------------------------|
|                        | Ch.1                                      | Ch.2   | Ch.3   | Ch.4   | Ch.5   | Ch.6   | Ch.7   | Ch.8   | Ch.9   |                                     |
| 20                     | 20.542                                    | 20.166 | 20.504 | 20.211 | 20.551 | 20.501 | 20.477 | 20.728 | 19.867 | 0.46                                |

| Setting temperature (°C) | Indicating Temperature (°C) | Measured stability (+/- °C) | Measured uniformity (°C) | Overall variation (°C) |
|--------------------------|-----------------------------|-----------------------------|--------------------------|------------------------|
| 20.0                     | 20 to 20.3                  | 0.25                        | 1.0                      | 1.3                    |



Front view

- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

UUC\* = Unit under calibration  
Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.  
Overall Variation = Difference of temperature value between the maximum and minimum any time.  
Stability = One half of the maximum difference of measured temperatures at any one probe.

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## INSPECTION REPORT

### 1. Product Information

|                   |                                                                                                                                            |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name      | Handheld DO Meter                                                                                                                          |
| Model             | LAQUA-DO210 / DO220                                                                                                                        |
| MFG No.           | HE3D0007                                                                                                                                   |
| Power Requirement | 2x AA batteries                                                                                                                            |
| Measuring range   | Dissolved oxygen : 0.00 to 20.00 mg/L<br>Saturated oxygen concentration : 0.0 to 200.0%<br>Temperature : -30.0 to 130.0 °C/-22 to 266.0 °F |

### 2. Test Results

- Appearance and Construction ----- Good
- Basic characteristic test ----- Good
  - a) Linearity -----

| Dissolved oxygen           |            | Temperature             |            |
|----------------------------|------------|-------------------------|------------|
| Within ±0.10 mg/L ±1 digit |            | Within ±0.5 °C ±1 digit |            |
| Input                      | Indication | Input                   | Indication |
| 0.00 mg/L                  | 0.01 mg/L  | 0.0 °C                  | 0.0 °C     |
| 8.26 mg/L                  | 8.27 mg/L  | 25.0 °C                 | 25.0 °C    |
| 19.62 mg/L                 | 19.63 mg/L | 90.0 °C                 | 90.0 °C    |

b) Repeatability ----- Within ±0.10 mg/L ±1 digit

- Operation test ----- Good
  - a) Operation test ----- No failures
- Accessories ----- Good
  - a) Accessories ----- All accessories are set.

### 3. Overall Judgment

Passed

|                   |           |              |  |
|-------------------|-----------|--------------|--|
| Date              | 2023.4.11 | Inspected by |  |
| Room Temp.        | 25 °C     | Approved by  |  |
| Relative Humidity | 65 %      |              |  |

HORIBA Advanced Techno, Co., Ltd.

IR-LAQUA-DO210/DO220(E)-RJ

## Accuracy Calibration Certificate

### Customer

Company: Environment Research & Technology Co., Ltd.  
Address: 25/114 Moo 6, Soi Chinakiet 1, Ngamwongwan Rd., Toongsonghong  
City: Lakki  
Zip / Postal: 10210  
State / Province: Bangkok  
Order Number:  0332617856

### Weighing Device

|               |                |                      |                     |
|---------------|----------------|----------------------|---------------------|
| Manufacturer: | Mettler Toledo | Instrument Type:     | Weighing Instrument |
| Model:        | MS204S/01      | Asset Number:        | ERTC-LN-088         |
| Serial No.:   | B334691537     | Terminal Model:      | N/A                 |
| Building:     | N/A            | Terminal Serial No.: | N/A                 |
| Floor:        | 5              | Terminal Asset No.:  | N/A                 |
| Room:         | 504            |                      |                     |
| Range         | Max. Capacity  | Readability (d)      |                     |
| 1             | 220 g          | 0.0001 g             |                     |

### Procedure

#### Calibration Guidelines:

EURAMET cg-18 v. 4.0 (11/2015)  
CPM002/20

#### METTLER TOLEDO Work Instruction:

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

| As Found | Temperature    |              | Humidity      |             |
|----------|----------------|--------------|---------------|-------------|
|          | Start: 23.7 °C | End: 23.6 °C | Start: 46.5 % | End: 45.6 % |

#### As Found Calibration Date:

17-Jan-2023

#### Calibrator:

#### As Left Calibration Date:

N/A

#### Issue Date:

19-Jan-2023

#### Approved Signatory:

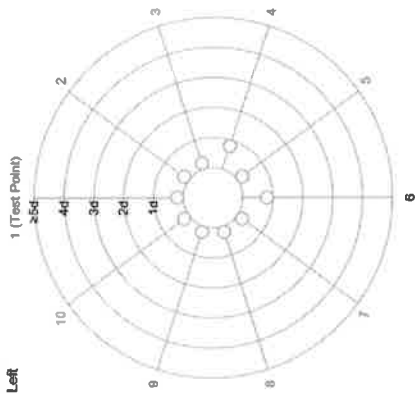
## Measurement Results

### Repeatability

Test Load: 100 g

|    | As Found  | As Left |
|----|-----------|---------|
| 1  | 99.9999 g | N/A     |
| 2  | 99.9999 g | N/A     |
| 3  | 99.9999 g | N/A     |
| 4  | 99.9998 g | N/A     |
| 5  | 99.9999 g | N/A     |
| 6  | 99.9998 g | N/A     |
| 7  | 99.9999 g | N/A     |
| 8  | 99.9999 g | N/A     |
| 9  | 99.9999 g | N/A     |
| 10 | 99.9999 g | N/A     |

|                    |           |     |
|--------------------|-----------|-----|
| Standard Deviation | 0.00004 g | N/A |
|--------------------|-----------|-----|

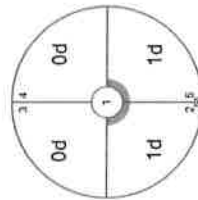


The "d" in the graph represents the readability of the range interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

### Eccentricity

Test Load: 100 g

| Position | As Found   | As Left |
|----------|------------|---------|
| 1        | 99.9999 g  | N/A     |
| 2        | 100.0000 g | N/A     |
| 3        | 99.9999 g  | N/A     |
| 4        | 99.9999 g  | N/A     |
| 5        | 100.0000 g | N/A     |



As Found

|                   |          |     |
|-------------------|----------|-----|
| Maximum Deviation | 0.0001 g | N/A |
|-------------------|----------|-----|

The "d" in the graph represents the readability of the range interval in which the test was performed.

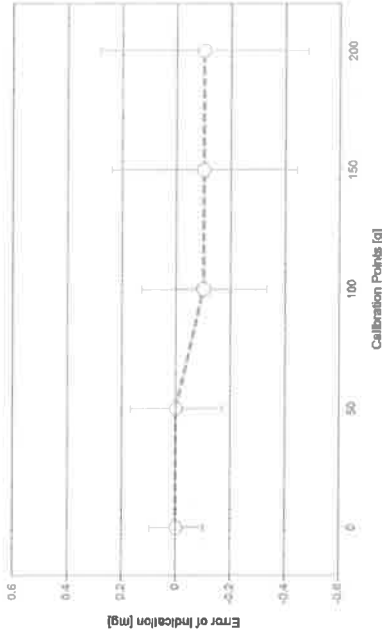
## Error of Indication

As Found

|    | Reference Value | Indication | Error of Indication | Expanded Uncertainty | k |
|----|-----------------|------------|---------------------|----------------------|---|
| 1  | 0.0000 g        | 0.0000 g   | 0.0000 g            | 0.10 mg              | 2 |
| 2  | 0.0500 g        | 0.0500 g   | 0.0000 g            | 0.12 mg              | 2 |
| 3  | 0.1000 g        | 0.1000 g   | 0.0000 g            | 0.12 mg              | 2 |
| 4  | 0.5000 g        | 0.5000 g   | 0.0000 g            | 0.12 mg              | 2 |
| 5  | 1.0000 g        | 1.0000 g   | 0.0000 g            | 0.12 mg              | 2 |
| 6  | 5.0000 g        | 5.0000 g   | 0.0000 g            | 0.13 mg              | 2 |
| 7  | 10.0000 g       | 10.0001 g  | 0.0001 g            | 0.13 mg              | 2 |
| 8  | 50.0000 g       | 50.0000 g  | 0.0000 g            | 0.17 mg              | 2 |
| 9  | 100.0000 g      | 99.9999 g  | -0.0001 g           | 0.23 mg              | 2 |
| 10 | 150.0000 g      | 149.9999 g | -0.0001 g           | 0.34 mg              | 2 |
| 11 | 200.0000 g      | 199.9999 g | -0.0001 g           | 0.38 mg              | 2 |

○ As Found

◆ As Left



For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.

The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

## Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OML E2

Weight Set No.: WS57

Date of Issue: 06-Jan-2022

Certificate Number: 177037

Calibration Due Date: 03-Jul-2023

Thermo Hygrometer

Equipment No.: IN255

Date of Issue: 20-Jul-2022

Certificate Number: 22H1503

Calibration Due Date: 04-Jul-2023

Remarks

- FACT adjustment functionality activated
- Equipment condition: Good
- Next calibration according to customer's procedure
- Calibration data not decide by calibration laboratory

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with  $k=2$  in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value  $R$  represents the net load indication in the unit of measure of the device.

|                                                                                     |                         |
|-------------------------------------------------------------------------------------|-------------------------|
| Temperature coefficient for the evaluation of the measurement uncertainty in use:   | $1.5 \cdot 10^{-4} / K$ |
| Temperature range on site for the evaluation of the measurement uncertainty in use: | 3 K                     |

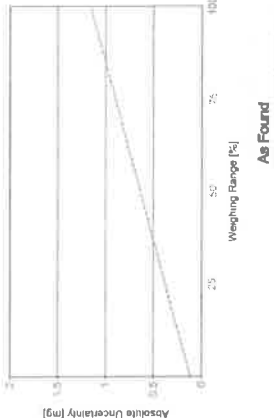
Uncertization of Uncertainty Equation

| Range |          | AS Found |                                                        | AS Left |     |
|-------|----------|----------|--------------------------------------------------------|---------|-----|
| d     | Max      |          |                                                        |         |     |
| 1     | 0.0001 g | 220 g    | $U_1 = 0.12 \text{ mg} + 0.00474 \text{ mg/g} \cdot R$ |         | N/A |

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Example)

| Net Indication |  | AS Found |          | AS Left |     |
|----------------|--|----------|----------|---------|-----|
| 0.0220 g       |  | 0.12 mg  | 0.55%    | N/A     | N/A |
| 0.2200 g       |  | 0.12 mg  | 0.055%   | N/A     | N/A |
| 2.2000 g       |  | 0.13 mg  | 0.0059%  | N/A     | N/A |
| 22.0000 g      |  | 0.22 mg  | 0.0010%  | N/A     | N/A |
| 220.0000 g     |  | 1.2 mg   | 0.00053% | N/A     | N/A |



# GWP® Certificate



AS  
Found

AS  
Left

The weighing device meets the given process requirements.

The weighing device meets the given process requirements.

Tests Performed:

☒ As Found

☐ As Left

☒ No adjustments/modifications made. As Left results correspond to As Found.

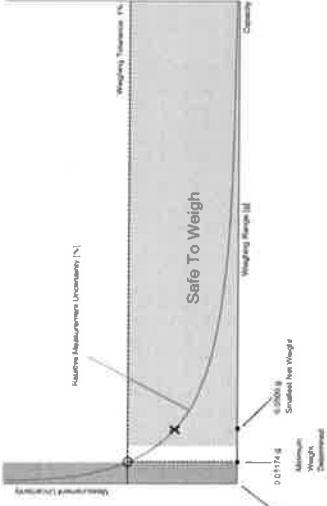
## Process Requirements

Weighing Tolerance: 1%

Smallest Net Weight: 0.0500 g

Safety Factor: 2

## Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

## Minimum Weight As Found Minimum Weight Table

| Minimum weights for different weighing tolerances and safety factors |           |           |           |           |           |
|----------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
| Tolerance                                                            | 1         | 2         | 3         | 5         | 10        |
| 0.1%                                                                 | 0.11794 g | 0.23700 g | 0.35721 g | 0.60113 g | 1.23215 g |
| 0.2%                                                                 | 0.05883 g | 0.11794 g | 0.17733 g | 0.29696 g | 0.60113 g |
| 0.5%                                                                 | 0.02350 g | 0.04704 g | 0.07063 g | 0.11794 g | 0.23700 g |
| 1%                                                                   | 0.01174 g | 0.02350 g | 0.03526 g | 0.05883 g | 0.11794 g |
| 2%                                                                   | 0.00587 g | 0.01174 g | 0.01762 g | 0.02938 g | 0.05883 g |
| 5%                                                                   | 0.00235 g | 0.00470 g | 0.00704 g | 0.01174 g | 0.02350 g |

Pass: The determined minimum weight meets the requirement for the smallest net weight.

## As Left Minimum Weight Table

| Minimum weights for different weighing tolerances and safety factors |           |           |           |           |           |
|----------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
| Tolerance                                                            | 1         | 2         | 3         | 5         | 10        |
| 0.1%                                                                 | 0.11794 g | 0.23700 g | 0.35721 g | 0.60113 g | 1.23215 g |
| 0.2%                                                                 | 0.05883 g | 0.11794 g | 0.17733 g | 0.29696 g | 0.60113 g |
| 0.5%                                                                 | 0.02350 g | 0.04704 g | 0.07063 g | 0.11794 g | 0.23700 g |
| 1%                                                                   | 0.01174 g | 0.02350 g | 0.03526 g | 0.05883 g | 0.11794 g |
| 2%                                                                   | 0.00587 g | 0.01174 g | 0.01762 g | 0.02938 g | 0.05883 g |
| 5%                                                                   | 0.00235 g | 0.00470 g | 0.00704 g | 0.01174 g | 0.02350 g |

Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with  $k = 2$  and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

## Notes on minimum weight values in above table:

1. If "N/A" is shown above, no appropriate value could be calculated.
2. METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

|          |   | Repeatability | Eccentricity | Error of Indication |
|----------|---|---------------|--------------|---------------------|
| As Found | ✓ | ✓             | ✓            | ✓                   |
| As Left  | ✓ | ✓             | ✓            | ✓                   |

✓ = Passed

✗ = Failed

⚠ = Safety Factor not met

Repeatability

Test Load: 100 g

| Tolerance | Control Limit | As Found       |        | As Left        |        |
|-----------|---------------|----------------|--------|----------------|--------|
|           |               | Std. Deviation | Result | Std. Deviation | Result |
| 0.1%      | N/A           |                | N/A    |                | N/A    |
| 0.2%      | 0.00005 g     |                | ✓      |                | ✓      |
| 0.5%      | 0.00013 g     |                | ✓      |                | ✓      |
| 1%        | 0.00025 g     |                | ✓      |                | ✓      |
| 2%        | 0.00050 g     |                | ✓      |                | ✓      |
| 5%        | 0.00125 g     | 0.00004 g*     |        | 0.00004 g*     | ✓      |

\*The calculated standard deviation value is below the rounding error of the balance. The 0.41\* $\sigma$  rule is used for the assessment of this repeatability test and the calculation of the minimum weight.

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

| Tolerance | Control Limit | As Found  |        | As Left   |        |
|-----------|---------------|-----------|--------|-----------|--------|
|           |               | Deviation | Result | Deviation | Result |
| 0.1%      | 0.0500 g      |           | ✓      |           | ✓      |
| 0.2%      | 0.1000 g      |           | ✓      |           | ✓      |
| 0.5%      | 0.2500 g      |           | ✓      |           | ✓      |
| 1%        | 0.5000 g      | 0.0001 g  | ✓      | 0.0001 g  | ✓      |
| 2%        | 1.0000 g      |           | ✓      |           | ✓      |
| 5%        | 2.5000 g      |           | ✓      |           | ✓      |

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

Error of Indication

As Found

| Reference Value | Error     | Control limits for various weighing tolerances |          |          |          |          |
|-----------------|-----------|------------------------------------------------|----------|----------|----------|----------|
|                 |           | 0.1%                                           | 0.2%     | 0.5%     | 1%       | 5%       |
| 0.0000 g        | 0.0000 g  | N/A                                            | N/A      | N/A      | N/A      | N/A      |
| 50.0000 g       | 0.0000 g  | 0.0250 g                                       | 0.0500 g | 0.1250 g | 0.2500 g | 1.2500 g |
| 100.0000 g      | -0.0001 g | 0.0500 g                                       | 0.1000 g | 0.2500 g | 0.5000 g | 2.5000 g |
| 150.0000 g      | -0.0001 g | 0.0750 g                                       | 0.1500 g | 0.3750 g | 0.7500 g | 3.7500 g |
| 200.0000 g      | -0.0001 g | 0.1000 g                                       | 0.2000 g | 0.5000 g | 1.0000 g | 5.0000 g |
| Result          |           | ✓                                              | ✓        | ✓        | ✓        | ✓        |

As Left

| Reference Value | Error     | Control limits for various weighing tolerances |          |          |          |          |
|-----------------|-----------|------------------------------------------------|----------|----------|----------|----------|
|                 |           | 0.1%                                           | 0.2%     | 0.5%     | 1%       | 5%       |
| 0.0000 g        | 0.0000 g  | N/A                                            | N/A      | N/A      | N/A      | N/A      |
| 50.0000 g       | 0.0000 g  | 0.0250 g                                       | 0.0500 g | 0.1250 g | 0.2500 g | 1.2500 g |
| 100.0000 g      | -0.0001 g | 0.0500 g                                       | 0.1000 g | 0.2500 g | 0.5000 g | 2.5000 g |
| 150.0000 g      | -0.0001 g | 0.0750 g                                       | 0.1500 g | 0.3750 g | 0.7500 g | 3.7500 g |
| 200.0000 g      | -0.0001 g | 0.1000 g                                       | 0.2000 g | 0.5000 g | 1.0000 g | 5.0000 g |
| Result          |           | ✓                                              | ✓        | ✓        | ✓        | ✓        |

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES : EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 23TM31  
Page : 1 of 3

## Certificate of Calibration

**Equipment :** Hot Air Oven  
**Manufacturer :** Binder  
**Model :** FED 115 E2  
**Serial No. :** 11-22823  
**ID No. :** ERTC-L-In.-076

**Submitted by :** Environment Research & Technology Company Limited.  
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,  
Toongsonghong, Laksi,  
Bangkok 10210  
**Location :** Laboratory (ERTC)

**Received Order :** 4 January 2023  
**Calibration Date :** 4 January 2023  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Preecha Hlahib

**Approved by :** Approved Signatory

( ) Pornthippa Tameyakul  
( / ) Malee Bulkruea  
( ) Suwit Imjai

**Issue Date :** 16 January 2023

**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 :** 2301-0002ON-2  
**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

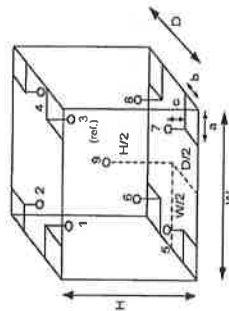
1. Reference standard Instrument:-

**Instrument** **Model** **Serial No.** **Cert. No.** **Due Date**  
1 ) Data Acquisition 34972A MY57013823 22LM24 26 Feb 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 |         |
|--------------------------------|---------|
| Temp. ( °C )                   | 28 32   |
| REL.Humid. ( % )               | 60 55   |
| AC Supply ( Volt )             | 220 221 |

| Ref. Std. ID No.: @ |                        |
|---------------------|------------------------|
| Position :          | Calibration Point      |
| 1                   | 21-17RTD-01 22-17TC-01 |
| 2                   | 21-17RTD-02 19-17TC-02 |
| 3                   | 17RTD-03 19-17TC-03    |
| 4                   | 17RTD-04 19-17TC-04    |
| 5                   | 17RTD-05 19-17TC-05    |
| 6                   | 17RTD-06 19-17TC-06    |
| 7                   | 17RTD-07 19-17TC-07    |
| 8                   | 17RTD-08 19-17TC-08    |
| 9 (ref.)            | 17RTD-09 19-17TC-09    |

**Probe Installation Details :**  
a = 5.0 cm D = 0.40 m  
b = 5.0 cm W = 0.60 m  
c = 5.0 cm H = 0.48 m  
Capacity = 0.12 m<sup>3</sup>



Equipment : Hot Air Oven  
Condition As-Received :  
Reference : 2301-0002ON-2  
Result of Calibration :-  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM31  
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                       | 104               | 104               | 0.16                         | 2.4                         | 2.6                    | 0.86              | 2                        |
| 180                       | 180               | 180               | 0.34                         | 6.1                         | 8.8                    | 1.8               | 2                        |
| Measured Temperature (°C) |                   |                   |                              |                             |                        |                   |                          |
| Position                  |                   |                   |                              |                             |                        |                   |                          |
| 1                         | 2                 | 3                 | 4                            | 5                           | 6                      | 7                 | 8                        |
| 104                       | 104.819           | 103.334           | 104.574                      | 104.185                     | 103.981                | 103.001           | 105.409                  |
| 180                       | 176.454           | 179.253           | 182.386                      | 180.810                     | 181.999                | 178.253           | 184.629                  |
|                           |                   |                   |                              |                             |                        |                   | 179.227                  |
|                           |                   |                   |                              |                             |                        |                   | 178.688                  |

Average\* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC\* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



MSC-TS/TEST/2025  
CALIBRATION 0000

Cert. No.: 23TM32  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UF 110  
Serial No. : B414.0652  
ID No. : ERTC-L-In-098

Submitted by : Environment Research & Technology Company Limited.  
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,  
Toongsonghong, Laksi,  
Bangkok 10210  
Location : Laboratory (ERTC)  
Received Order : 4 January 2023  
Calibration Date : 4 January 2023  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Preecha Hahib

Approved by :  
( ) Ponthippa Tameyakul  
( ) Malee Buikruea  
( ) Suwit Imjai  
Approved Signatory

Issue Date : 16 January 2023

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 :** 2301-0002ON-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 MY57013823 22LM24 26 Feb 2023

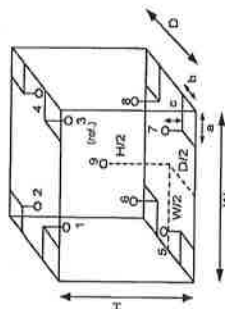
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



**Probe Installation Details :**

**Dimension of Chamber :**  
a = 5.0 cm  
b = 5.0 cm  
c = 5.0 cm  
D = 0.40 m  
W = 0.56 m  
H = 0.48 m  
Capacity = 0.11 m<sup>3</sup>



**Equipment :** Hot Air Oven  
**Condition As-Received :** Used Item  
**Reference :** 2301-0002ON-3  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Close

| Calibration Point (°C) | UUC* Setting (°C) | UUC* Reading (°C) | Temperature stability (± °C) | Temperature uniformity (°C) | Overall Variation (°C) | Uncertainty (±°C) | Coverage Factor k |
|------------------------|-------------------|-------------------|------------------------------|-----------------------------|------------------------|-------------------|-------------------|
| 104.0                  | 104.0             | 104.0             | 0.10                         | 0.95                        | 1.6                    | 0.42              | 2                 |
| 180.0                  | 180.0             | 180.0             | 0.29                         | 1.8                         | 3.3                    | 1.1               | 2                 |

| Measured Temperature ( °C ) |         |         |         |         |         |         |         |          |
|-----------------------------|---------|---------|---------|---------|---------|---------|---------|----------|
| Position                    |         |         |         |         |         |         |         |          |
| 1                           | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9 (ref.) |
| 104.0                       | 104.530 | 103.574 | 103.239 | 103.951 | 104.422 | 104.052 | 103.192 | 104.041  |
| 180.0                       | 179.591 | 179.816 | 178.321 | 179.612 | 181.116 | 179.997 | 178.605 | 179.735  |

**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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Mettler-Toledo (Thailand) Ltd.  
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0382  
MT-TH-ServiceSupport@mtl.com



## Accuracy Calibration Certificate

## Customer

Company: Environment Research & Technology Co., Ltd.  
Address: 25/114 Moo 6, Soi Chinakot 1, Ngamwongwan Rd., Toongsongkhong  
City: Lakso  
Contact: Ramita Taengthai  
Zip / Postal: 10210  
State / Province: Bangkok  
Order Number: 0332617856

## Weighing Device

Manufacturer: Mettler Toledo  
Model: MS204TSJ00  
Serial No.: B547728937  
Building: N/A  
Floor: 5  
Room: 504  
Instrument Type: Weighing Instrument  
Asset Number: ERTC-LJN-114  
Terminal Model: N/A  
Terminal Serial No.: N/A  
Terminal Asset No.: N/A

| Range | Max. Capacity | Repeatability (g) |
|-------|---------------|-------------------|
| 1     | 220 g         | 0.0001 g          |

## Procedure

Calibration Guideline:  
METTLER TOLEDO Work Instructions  
This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.  
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

| As Found | Temperature    |              | Humidity      |             |
|----------|----------------|--------------|---------------|-------------|
|          | Start: 23.7 °C | End: 23.8 °C | Start: 45.6 % | End: 46.8 % |

As Found Calibration Date: 17-Jan-2023  
As Left Calibration Date: N/A  
Issue Date: 19-Jan-2023

Approved Signatory

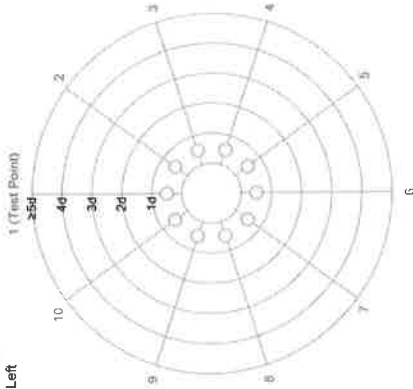
## Measurement Results

## Repeatability

Test Load: 100 g

|    | As Found   | As Left |
|----|------------|---------|
| 1  | 99.9999 g  | N/A     |
| 2  | 99.9999 g  | N/A     |
| 3  | 99.9999 g  | N/A     |
| 4  | 100.0000 g | N/A     |
| 5  | 100.0000 g | N/A     |
| 6  | 99.9999 g  | N/A     |
| 7  | 99.9999 g  | N/A     |
| 8  | 100.0000 g | N/A     |
| 9  | 100.0000 g | N/A     |
| 10 | 100.0000 g | N/A     |

|                    |           |     |
|--------------------|-----------|-----|
| Standard Deviation | 0.00005 g | N/A |
|--------------------|-----------|-----|



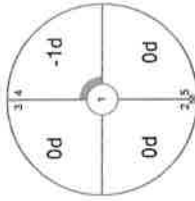
The "d" in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

## Eccentricity

Test Load: 100 g

| Position | As Found  | As Left |
|----------|-----------|---------|
| 1        | 99.9999 g | N/A     |
| 2        | 99.9999 g | N/A     |
| 3        | 99.9999 g | N/A     |
| 4        | 99.9998 g | N/A     |
| 5        | 99.9999 g | N/A     |

|                   |          |     |
|-------------------|----------|-----|
| Maximum Deviation | 0.0001 g | N/A |
|-------------------|----------|-----|

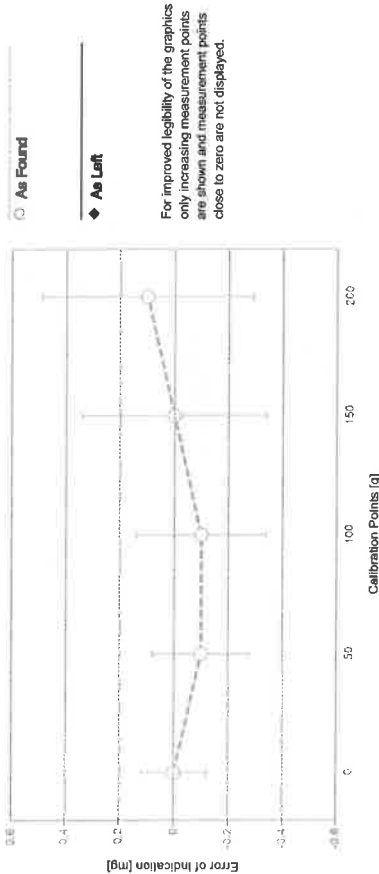


As Found

The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

| As Found | Reference Value | Indication | Error of Indication | Expanded Uncertainty | k |
|----------|-----------------|------------|---------------------|----------------------|---|
| 1        | 0.0000 g        | 0.0000 g   | 0.0000 g            | 0.12 mg              | 2 |
| 2        | 0.0500 g        | 0.0500 g   | 0.0000 g            | 0.13 mg              | 2 |
| 3        | 0.1000 g        | 0.1000 g   | 0.0000 g            | 0.13 mg              | 2 |
| 4        | 0.5000 g        | 0.5000 g   | 0.0000 g            | 0.14 mg              | 2 |
| 5        | 1.0000 g        | 1.0000 g   | 0.0000 g            | 0.14 mg              | 2 |
| 6        | 5.0000 g        | 5.0001 g   | 0.0001 g            | 0.14 mg              | 2 |
| 7        | 10.0000 g       | 10.0001 g  | 0.0001 g            | 0.15 mg              | 2 |
| 8        | 50.0000 g       | 49.9999 g  | -0.0001 g           | 0.18 mg              | 2 |
| 9        | 100.0000 g      | 99.9999 g  | -0.0001 g           | 0.24 mg              | 2 |
| 10       | 150.0000 g      | 150.0000 g | 0.0000 g            | 0.34 mg              | 2 |
| 11       | 200.0000 g      | 200.0001 g | 0.0001 g            | 0.39 mg              | 2 |



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor  $k$  - which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

|                     |        |                       |             |
|---------------------|--------|-----------------------|-------------|
| Weight Set No.:     | WS57   | Date of Issue:        | 06-Jan-2022 |
| Certificate Number: | 177037 | Calibration Due Date: | 03-Jul-2023 |

Thermo Hygrometer

|                     |         |                       |             |
|---------------------|---------|-----------------------|-------------|
| Equipment No.:      | IN255   | Date of Issue:        | 20-Jul-2022 |
| Certificate Number: | 22H1503 | Calibration Due Date: | 04-Jul-2023 |

Remarks

- FACT adjustment functionality activated
- Equipment condition: Good
- Next calibration according to customer's procedure
- Calibration data not decide by calibration laboratory

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

### Measurement Uncertainty of the Weighing Instrument In Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $3.0 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

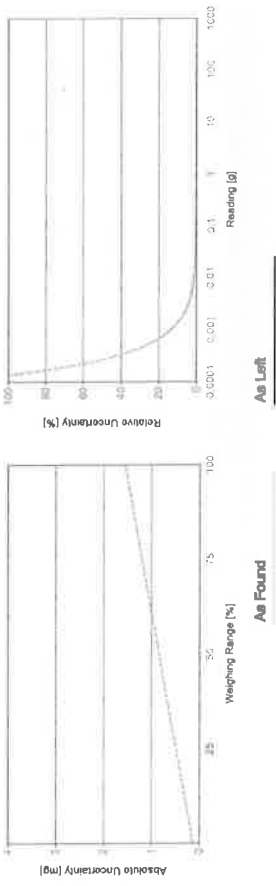
#### Uncertainties of Uncertainty Equation

| Range<br>d | As Found |       | As Left |
|------------|----------|-------|---------|
|            | Min      | Max   |         |
| 1          | 0.0001 g | 220 g | N/A     |

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

#### Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Example)

| Net Indication | As Found |             | As Left |             |
|----------------|----------|-------------|---------|-------------|
|                | Value    | Uncertainty | Value   | Uncertainty |
| 0.0020 g       | 0.13 mg  | 0.59%       | N/A     | N/A         |
| 0.2200 g       | 0.13 mg  | 0.060%      | N/A     | N/A         |
| 2.2000 g       | 0.14 mg  | 0.0066%     | N/A     | N/A         |
| 22.0000 g      | 0.27 mg  | 0.0012%     | N/A     | N/A         |
| 220.0000 g     | 1.6 mg   | 0.00071%    | N/A     | N/A         |



GWP®

Certificate



As Found

As Left

The weighing device meets the given process requirements.

The weighing device meets the given process requirements.

Tests Performed:

☒ As Found

☐ As Left

No adjustments/modifications made. As Left results correspond to As Found.

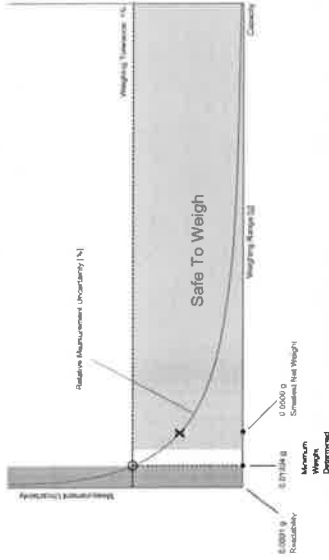
### Process Requirements

Weighing Tolerance: 1%

Smallest Net Weight: 0.0500 g

Safety Factor: 2

#### Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

Minimum Weight

As Found Minimum Weight Table

| Minimum weights for different weighing tolerances and safety factors |           |           |           |           |           |
|----------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
| Safety Factor                                                        |           |           |           |           |           |
| Tolerance                                                            | 1         | 2         | 3         | 5         | 10        |
| 0.1%                                                                 | 0.13420 g | 0.27016 g | 0.40792 g | 0.68895 g | 1.42555 g |
| 0.2%                                                                 | 0.06688 g | 0.13420 g | 0.20196 g | 0.33881 g | 0.68895 g |
| 0.5%                                                                 | 0.02670 g | 0.05347 g | 0.08031 g | 0.13420 g | 0.27016 g |
| 1%                                                                   | 0.01334 g | 0.02670 g | 0.04008 g | 0.06688 g | 0.13420 g |
| 2%                                                                   | 0.00667 g | 0.01334 g | 0.02002 g | 0.03339 g | 0.06688 g |
| 5%                                                                   | 0.00267 g | 0.00533 g | 0.00800 g | 0.01334 g | 0.02670 g |

Pass: The determined minimum weight meets the requirement for the smallest net weight.

As Left Minimum Weight Table

| Minimum weights for different weighing tolerances and safety factors |           |           |           |           |           |
|----------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
| Safety Factor                                                        |           |           |           |           |           |
| Tolerance                                                            | 1         | 2         | 3         | 5         | 10        |
| 0.1%                                                                 | 0.13420 g | 0.27016 g | 0.40792 g | 0.68895 g | 1.42555 g |
| 0.2%                                                                 | 0.06688 g | 0.13420 g | 0.20196 g | 0.33881 g | 0.68895 g |
| 0.5%                                                                 | 0.02670 g | 0.05347 g | 0.08031 g | 0.13420 g | 0.27016 g |
| 1%                                                                   | 0.01334 g | 0.02670 g | 0.04008 g | 0.06688 g | 0.13420 g |
| 2%                                                                   | 0.00667 g | 0.01334 g | 0.02002 g | 0.03339 g | 0.06688 g |
| 5%                                                                   | 0.00267 g | 0.00533 g | 0.00800 g | 0.01334 g | 0.02670 g |

Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with  $k = 2$  and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

Notes on minimum weight values in above table:

1. If "N/A" is shown above, no appropriate value could be calculated.
2. METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

| Repeatability |               |              |                     |
|---------------|---------------|--------------|---------------------|
| As Found      | Repeatability | Eccentricity | Error of Indication |
| As Left       | ✓             | ✓            | ✓                   |

✓ = Passed  
✗ = Failed  
Δ = Safety Factor not met

Repeatability

Test Load: 100 g

| Tolerance |  | Control Limit |  | As Found       |        | As Left        |        |
|-----------|--|---------------|--|----------------|--------|----------------|--------|
|           |  |               |  | Std. Deviation | Result | Std. Deviation | Result |
| 0.1%      |  | N/A           |  |                | N/A    |                | N/A    |
| 0.2%      |  | 0.00005 g     |  |                | ✓      |                | Δ      |
| 0.5%      |  | 0.00013 g     |  |                | ✓      |                | ✓      |
| 1%        |  | 0.00025 g     |  |                | ✓      |                | ✓      |
| 2%        |  | 0.00050 g     |  |                | ✓      |                | ✓      |
| 5%        |  | 0.00125 g     |  |                | ✓      |                | ✓      |

\*The calculated standard deviation value is below the rounding error of the balance. The 0.41\*d rule is used for the assessment of this repeatability test and the calculation of the minimum weight.

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

| Tolerance |  | Control Limit |  | As Found  |        | As Left   |        |
|-----------|--|---------------|--|-----------|--------|-----------|--------|
|           |  |               |  | Deviation | Result | Deviation | Result |
| 0.1%      |  | 0.0500 g      |  |           | ✓      |           | ✓      |
| 0.2%      |  | 0.1000 g      |  |           | ✓      |           | ✓      |
| 0.5%      |  | 0.2500 g      |  |           | ✓      |           | ✓      |
| 1%        |  | 0.5000 g      |  |           | ✓      |           | ✓      |
| 2%        |  | 1.0000 g      |  |           | ✓      |           | ✓      |
| 5%        |  | 2.5000 g      |  |           | ✓      |           | ✓      |

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

As Found

| Control limits for various weighing tolerances |           |          |          |          |          |          |          |   |   |
|------------------------------------------------|-----------|----------|----------|----------|----------|----------|----------|---|---|
| Reference Value                                | Error     | 0.1%     | 0.2%     | 0.5%     | 1%       | 2%       | 5%       |   |   |
| 0.0000 g                                       | 0.0000 g  | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      |   |   |
| 50.0000 g                                      | -0.0001 g | 0.0250 g | 0.0500 g | 0.1250 g | 0.2500 g | 0.5000 g | 1.2500 g |   |   |
| 100.0000 g                                     | -0.0001 g | 0.0500 g | 0.1000 g | 0.2500 g | 0.5000 g | 1.0000 g | 2.5000 g |   |   |
| 150.0000 g                                     | 0.0000 g  | 0.0750 g | 0.1500 g | 0.3750 g | 0.7500 g | 1.5000 g | 3.7500 g |   |   |
| 200.0000 g                                     | 0.0001 g  | 0.1000 g | 0.2000 g | 0.5000 g | 1.0000 g | 2.0000 g | 5.0000 g |   |   |
| Result                                         |           | ✓        | ✓        | ✓        | ✓        | ✓        | ✓        | ✓ | ✓ |

As Left

| Control limits for various weighing tolerances |           |          |          |          |          |          |          |   |   |
|------------------------------------------------|-----------|----------|----------|----------|----------|----------|----------|---|---|
| Reference Value                                | Error     | 0.1%     | 0.2%     | 0.5%     | 1%       | 2%       | 5%       |   |   |
| 0.0000 g                                       | 0.0000 g  | N/A      | N/A      | N/A      | N/A      | N/A      | N/A      |   |   |
| 50.0000 g                                      | -0.0001 g | 0.0250 g | 0.0500 g | 0.1250 g | 0.2500 g | 0.5000 g | 1.2500 g |   |   |
| 100.0000 g                                     | -0.0001 g | 0.0500 g | 0.1000 g | 0.2500 g | 0.5000 g | 1.0000 g | 2.5000 g |   |   |
| 150.0000 g                                     | 0.0000 g  | 0.0750 g | 0.1500 g | 0.3750 g | 0.7500 g | 1.5000 g | 3.7500 g |   |   |
| 200.0000 g                                     | 0.0001 g  | 0.1000 g | 0.2000 g | 0.5000 g | 1.0000 g | 2.0000 g | 5.0000 g |   |   |
| Result                                         |           | ✓        | ✓        | ✓        | ✓        | ✓        | ✓        | ✓ | ✓ |

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.

## Preventive Maintenance Block Digestion

Service No. PM23-S08-115

### 1. Customer Information

| Customer Name                                                                                                                                                                                            | Instrument | Serial Number | Service Date          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------|-----------------------|
| บริษัท เอ็นไวรอนเม้นท์ โซลูชัน<br>แอนด์ เทคโนโลยี จำกัด<br>25/114 หมู่ 6 ซ.ชินเขต 1<br>ถ.งามวงศ์วาน ทั้งสองห้อง<br>หลักสี่ กรุงเทพมหานคร 10210<br>ติดต่อ: คุณปริดา แดงไทย<br>Tel: 086-633 4490<br>Fax: - | K- 449     | 1000299283    | 06-Jul-2023<br>PM_1/1 |

### 2. Instrument

|                                   | OK | NOT OK | Remark       |
|-----------------------------------|----|--------|--------------|
| 2.1 Housing                       |    |        |              |
| - Clean the housing               | /  |        |              |
| - Visual check                    | /  |        |              |
| - Check for defects (e.g. cracks) | /  |        |              |
| 2.2 Heating                       |    |        |              |
| - Clean aluminum block            | /  |        |              |
| - Visual check                    | /  |        |              |
| - Check heating element           | /  |        | เปลี่ยน/ใหม่ |



## Preventive Maintenance Block Digestion

| 2.3 Visual Check        | OK | NOT OK | Remark |
|-------------------------|----|--------|--------|
| - Connection to suction | /  |        |        |
| - PTFE seal             | /  |        |        |
| - O-ring                | /  |        |        |
| - Glass holder set      | /  |        |        |
| - Suction module        | /  |        |        |

### 2.4 Function test (This test does not use digestion vessels!)

- Select and store in Program 9 by following parameters:
  - Step 1 Ramp 1 Temp. 55°C Time 2 min.
  - Step 2 Ramp 2 Temp. 70°C Time 2 min.
  - Step 3 Ramp 3 Temp. 85°C Time 2 min.
  - Step 4 Ramp 4 Temp. 100°C Time 2 min.
  - Step 5 Cool Time 10 min.
- Check following functions:
  - Press key "Start": Start Time 00.00
  - 0 min. press key "Start. again starts heating from room temperature (LED Heating on)
  - 5 min. reaches 55°C (LED off) Lift goes down (K-438 only)
  - 6 min. starts heating again (LED on)
  - 7 min. reaches 70°C (LED off)
  - 8 min. starts heating again (LED on)
  - 9 min. reaches 85°C (LED off)
  - 10 min. starts heating again (LED on)
  - 11 min. reaches 100°C (LED off)
  - 12 min. starts cooling (fan on) Lift goes up (K-438 only)
  - 22 min. End / Scrubber off; LED still flashing displays 'power off delay - cooling' (Instrument will switch off automatically, if temperature of the heating block drops below 60°C)
- Note:
  - This are only approximate times starting from room temperature and they can vary slightly!
  - Not all heating positions have exactly the same heating output! (Constructive matter)
  - Temperatures may overshoot set temperatures. (only below 100°C)

### Function test

☒ OK ☐ NOT OK



Buchi (Thailand) Limited

## Preventive Maintenance Block Digestion

| 2.5 System control | OK | NOT OK | Remark |
|--------------------|----|--------|--------|
| - Keyboard         | /  |        |        |
| - Display          | /  |        |        |
| - Program          | /  |        |        |

### 3. Summary

| All specifications OK | Specification not OK |
|-----------------------|----------------------|
| OK                    |                      |

### Comments

- Preventive Maintenance + Performance test\_1/1
- TEST Run เครื่องทำงานปกติ

### Signature BUCHI

- Service by

Date 06 - Jul - 2023

- Approve by

Date 10 - Jul - 2023



Buchi (Thailand) Limited

## Preventive Maintenance Kjeldahl

Service No. PM23-S08-115

### 1. Customer Information

| Customer Name                                                                                                                                                                       | Instrument | Serial Number | Service Date          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------|-----------------------|
| บริษัท เอ็นโวลูชั่น เทคโนโลยี จำกัด<br>25/114 หมู่ 6 ซ.วิเศษ 1<br>ถ.งามวงศ์วาน ซอยสองห้อง หลักสี่<br>กรุงเทพมหานคร 10210<br>ติดต่อ: คุณเมธิดา แดงไทย<br>Tel: 086-633 4490<br>Fax: - | K- 449     | 1000299283    | 06-Jul-2023<br>PM_1/1 |

### 2. Instrument

| 2.1 Cooling water (if it connected) | OK | NOT OK | Remark        |
|-------------------------------------|----|--------|---------------|
| - Temperature 15 – 20 °C            | /  |        | CTL-911       |
| - Cooling water inlet               | /  |        |               |
| - Cooling water outlet              | /  |        |               |
| - Control Temperature               | /  |        | Set temp 15 C |

### 2.2 Cleaning

|                      | DONE | NOT DONE | Remark |
|----------------------|------|----------|--------|
| - Outside Instrument | /    |          |        |
| - Inside Instrument  | /    |          |        |
| - Splash protector   | /    |          |        |
| - Condenser          | /    |          |        |

## Preventive Maintenance Kjeldahl

### 2.3 Visual Test

|                                                           | OK | NOT OK | Remark |
|-----------------------------------------------------------|----|--------|--------|
| - Screw Coupling (between splash protector and condenser) | /  |        |        |
| - Condenser                                               | /  |        |        |
| - Splash protector                                        | /  |        |        |
| - Hypalon connection (connection tube)                    | /  |        |        |
| - Rubber bung                                             | /  |        |        |
| - Ventilation valve                                       | /  |        |        |
| - PTFE tube                                               | /  |        |        |
| - Cooling water inlet                                     | /  |        |        |
| - Cooling water outlet                                    | /  |        |        |
| - Magnetic valve                                          | /  |        |        |

### 2.4 System control

|                                         | OK | NOT OK | Remark      |
|-----------------------------------------|----|--------|-------------|
| - Key board                             | /  |        |             |
| - Display                               | /  |        |             |
| - Program                               | /  |        |             |
| - Adding H <sub>2</sub> O               | /  |        | Reagent 1   |
| - Adding NaOH                           | /  |        | Reagent 2   |
| - Adding H <sub>3</sub> BO <sub>3</sub> | -  |        | Do not have |
| - Aspiration                            | -  |        | Do not have |

## Preventive Maintenance Kjeldahl

| 2.5 System Distillation    | OK | NOT OK | Remark      |
|----------------------------|----|--------|-------------|
| - Boiler                   | /  |        | 7.1 Amp     |
| - Water level sensor       | /  |        |             |
| - One way valve            | /  |        |             |
| - Pressure switch          | /  |        |             |
| - Thermostat               | /  |        |             |
| - Steam valve1 (Y4)        | /  |        |             |
| - Steam valve2 (Y5)        | -  |        | Do not have |
| - Drain valve (Y3)         | -  |        | Do not have |
| - Water 3/2 way valve (Y1) | -  |        | Do not have |

| 2.6 Hose        | OK | NOT OK | Remark      |
|-----------------|----|--------|-------------|
| - Unisil hose   | /  |        |             |
| - Hypalon hose  | /  |        |             |
| - Drain hose    | -  |        | Do not have |
| - Viton hose    | /  |        |             |
| - Silicone hose | -  |        | Do not have |

| 2.7 Diaphragm pump                                  | OK | NOT OK | Remark      |
|-----------------------------------------------------|----|--------|-------------|
| - Diaphragm pump for H <sub>2</sub> O               | /  |        |             |
| - Diaphragm pump for NaOH                           | /  |        |             |
| - Diaphragm pump for H <sub>3</sub> BO <sub>3</sub> | -  |        | Do not have |

| 2.8 Program test | OK | NOT OK | Remark      |
|------------------|----|--------|-------------|
| - Distillation   | -  |        | Do not have |
| - Aspiration     | -  |        | Do not have |
| - Preheating     | -  |        | Do not have |
| - Cleaning       | -  |        | Do not have |



Buchi (Thailand) Limited

## Preventive Maintenance Kjeldahl

| 3. Function Test                                                   | 0 ml | Reaction time     | 0 min |
|--------------------------------------------------------------------|------|-------------------|-------|
| Addition H <sub>2</sub> O                                          | 0 ml | Distillation time | 5 min |
| Addition NaOH                                                      | 0 ml | Steam capacity    | 100%  |
| Addition H <sub>3</sub> BO <sub>3</sub>                            | 0 ml | Aspiration        | SAM   |
| Result: Water in receiving vessel now approximately 170 ml, 172 ml |      |                   |       |

## 4. Summary

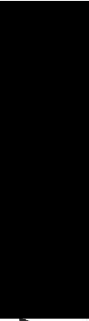
| All specifications OK | Specification not OK |
|-----------------------|----------------------|
| OK                    |                      |

## Comments

- Preventive Maintenance + Performance test\_1/1
- TEST Run เครื่องทำงานปกติ

## Signature BUCHI

- Service by  Date 06 - Jul - 2023

- Approve by  Date 10 - Jul - 2023



Buchi (Thailand) Limited

## Performance Test

### 1. Customer Information

Service No. PM23-S08-115

| Customer Name                                                                                                                                                | Instrument              | Serial Number                          | Service Date            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------------------------|-------------------------|
| บริษัท เอ็นไวรอนเม้นท์ รีเสิร์ช<br>แอนด์ เทคโนโลยี จำกัด<br>25/114 หมู่ 6 ซอยดินแดง 1<br>ถนนนางลิ้นจี่ แขวงทุ่งสอง<br>ห้อง เขตหลักสี่<br>กรุงเทพมหานคร 10210 | K-355<br>K-449<br>B-414 | 1000142231<br>1000299283<br>0700002874 | 06 July 2023<br>(PM1/1) |
| Tel: 02-954-7745<br>Fax:                                                                                                                                     |                         |                                        |                         |

### 2. Methods and Reagents

| Digestion (assay 100.1%) |                     | Distillation and Titration (assay 100.2%) |                                      |
|--------------------------|---------------------|-------------------------------------------|--------------------------------------|
| Standard Substance:      | Glycine             | Standard Substance                        | Ammonium Sulfate                     |
| Theoretical %N content   | 18.618%             | Theoretical %N content                    | 21.24%                               |
| Catalyst                 | Mixed catalyst 10 g | Titration method                          | Boric acid                           |
| Sulfuric acid            | 20 ml               | Distilled water                           | 50 ml                                |
| Heating Level or Temp    | 420 °C              | NaOH 32 %                                 | 90 ml                                |
| Digestion time           | 90 min              | Boric acid 2 %                            | 60 ml                                |
| Cooling time             | 30 min              | Titant                                    | 0.5 N H <sub>2</sub> SO <sub>4</sub> |

## Performance Test

### 3. Results

| No.     | Sample           | Sample Weight<br>(g) | Volume of<br>titrant (ml) | Nitrogen<br>(%) | Recovery<br>Rate (%) |
|---------|------------------|----------------------|---------------------------|-----------------|----------------------|
| 1       | Blank            | -                    | 0.05                      |                 |                      |
| 2       | Blank            | -                    | 0.05                      |                 |                      |
| 3       | Ammonium Sulfate | 0.2073               | 6.30                      | 21.12           | 99.46                |
| 4       | Ammonium Sulfate | 0.2074               | 6.30                      | 21.11           | 99.41                |
| 5       | Ammonium Sulfate | 0.2072               | 6.30                      | 21.13           | 99.51                |
| 6       | Ammonium Sulfate | 0.2073               | 6.30                      | 21.12           | 99.46                |
| Average |                  |                      |                           | 21.12%          | 99.46 %              |

Recovery Rate: 99.46 % ☒ Passed ☐ Failed  
Relative Standard Deviation (RSD): 0.04 % ☒ Passed ☐ Failed

| No.     | Sample  | Sample Weight<br>(g) | Volume of<br>titrant (ml) | Nitrogen<br>(%) | Recovery<br>Rate (%) |
|---------|---------|----------------------|---------------------------|-----------------|----------------------|
| 1       | Blank   | -                    | 0.05                      |                 |                      |
| 2       | Blank   | -                    | 0.05                      |                 |                      |
| 3       | Glycine | 0.2058               | 5.50                      | 18.55           | 99.49                |
| 4       | Glycine | 0.2061               | 5.50                      | 18.52           | 99.35                |
| 5       | Glycine | 0.2065               | 5.50                      | 18.48           | 99.16                |
| 6       | Glycine | 0.2063               | 5.50                      | 18.50           | 99.25                |
| Average |         |                      |                           | 18.51%          | 99.31%               |

Recovery Rate: 99.31 % ☐ Passed ☐ Failed  
Relative Standard Deviation (RSD): 0.14 % ☐ Passed ☐ Failed

#### Note:

- The recovery rate should be between 98 – 102 %
- The relative standard deviation should be lower than 1 %

## Performance Test

### 4. Summary

|                                                                                                                                                                                                                                                                                                                   |                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| All specifications OK                                                                                                                                                                                                                                                                                             | Specification not OK |
| OK                                                                                                                                                                                                                                                                                                                |                      |
| <p><b>Comments</b><br/>% Recovery : Pass</p>                                                                                                                                                                                                                                                                      |                      |
| <p><b>Signature BUCHI</b></p> <p><b>- Service by</b>  <b>Date</b> 06 July 2023</p> <p><b>- Approve by</b>  <b>Date</b> 07 July 2023</p> |                      |

## Preventive Maintenance Scrubber

Service No. PM23-S08-115

### 1. Customer Information

| Customer Name                                                                                                                                                                                         | Instrument | Serial Number | Service Date          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------|-----------------------|
| บริษัท เ็นวอเรนเมนท์ รีเสิร์ช<br>แอนด์ เทคโนโลยี จำกัด<br>25/114 หมู่ 6 ซ.ชินเขต 1<br>ถ.งามวงศ์วาน พงสองห้อง<br>หลักสี่ กรุงเทพมหานคร 10210<br>ติดต่อ: คุณรณิดา แดงไทย<br>Tel: 086-633 4490<br>Fax: - | K- 449     | 1000299283    | 06-Jul-2023<br>PM_1/1 |

### 2. Instrument

| 2.1 Cooling water (If it connected) | OK   | NOT OK   | Remark  |
|-------------------------------------|------|----------|---------|
| - Temperature 10 – 20 °C            | /    |          | CTL-901 |
| - Cooling water inlet               | /    |          |         |
| - Cooling water outlet              | /    |          |         |
| 2.2 Cleaning                        | DONE | NOT DONE | Remark  |
| - Housing                           | /    |          |         |
| - Condenser                         | /    |          |         |
| - Swift disc                        | /    |          |         |

## Preventive Maintenance Scrubber

| 2.3 Visual Check             | OK | NOT OK | Remark |
|------------------------------|----|--------|--------|
| - Hose connection to suction | /  |        |        |
| - Glassware                  | /  |        |        |
| - Lip gasket                 | /  |        |        |
| - GL-14 connector            | /  |        |        |
| - Activated charcoal         | /  |        |        |

### 2.4 Flush Pump

- Make sure, the bypass valve is closed completely (for maximum suction power).
- Disconnect the silencer, move it down (or take it away from the instrument), and flush out the pump with at least 500 mL of distilled water through the pump inlet, until the collected washing water is clean.
  - Switch on the instrument and collect the waste water from the pump output in a suitable vessel.

#### Flush pump

☒ OK

☐ NOT OK

### 2.5 Washing Solution

- Sodium hydroxide 8-10 %, max. 20 %
- Sodium carbonate
  - dissolve 600 g  $\text{Na}_2\text{CO}_3$  in 3 L distilled warm water, or
  - dissolve 1.7 kg  $\text{Na}_2\text{CO}_3$  in 10 H<sub>2</sub>O in 3 L distilled warm water

#### Washing solution

☒ OK

☐ NOT OK

## Preventive Maintenance Scrubber

### 3. Summary

| All specifications OK | Specification not OK |
|-----------------------|----------------------|
| OK                    |                      |

#### Comments

- Preventive Maintenance + Performance test\_1/1
- TEST Run เครื่องทำงานปกติ

#### Signature BUCHI

- Service by

Date 06 - Jul - 2023

- Approve by

Date 10 - Jul - 2023