# Declaration of Quality

## Hamilton Basic Line Conductivity Standard 1413 µS/cm

| | |
|---|---|
| Reference number: | 238986 |
| Production lot number: | 111043474 |
| Actual value[1] (2019-01-22): | 1413.07 µS/cm at 25°C (DFM certificate C1906) |
| Standard deviation on production lot: | < 2 µS/cm |
| Accuracy until expiry date: | Actual value +/- 14 µS/cm at 25°C |
| Expiry date: | 2020-07-15 |

**Standardization:**

The electrolytic conductivity is determined independently at Hamilton and at DFM[2]. The agreement between the two independent measurements is imperatively below 1 %. The actual value given above is the value obtained at DFM (calibration certificate on the backside). DFM is using an absolute conductivity cell which is directly traceable to meter and ohm of the International System of Units (SI). The equipment was built in collaboration with NIST[4] based on the same measurement principle and basic design. Accordingly, the measurements at NIST and at DFM are equivalent (Metrologia, vol. 38, no. 6, 549-554 (2001)).

The conductivity measurement at Hamilton is performed on a certified system which is traceable to ASTM[5] standard D1125-95 and to NIST. The expanded uncertainty (k=2) of the total conductivity system is below 1 % at 1413 µS/cm.

The stated uncertainty of the conductivity value of the standard solution is shown on the label. This uncertainty references to the "actual value" and is valid until the expiry date, when stored according to the label on the bottle.

1 Determined on a representative amount of sample from this production lot at DFM.

2 Danish Institute of Fundamental Metrology, Lyngby, Denmark. Accredited by DANAK[3] for conductivity measurements down to 0.9 µS/cm (accreditation no. 255).

3 Danish National Accreditation Body, Copenhagen, Denmark. Signatory to the multilateral agreements of the European cooperation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

4 National Institute of Standards and Technology, Gaithersburg, USA.

5 American Society for Testing and Materials, West Conshohocken, USA.

Passed by Quality Control: Nicole Kalt 2019-01-23

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# Instructions for Calibration with Conductivity Standard Solutions

## Intended use

The Hamilton Conductivity Standards are intended for use in electrolytic conductivity measurement as a calibration standard (determination of the cell constant) or as validation sample.

## Storage condition

Closed bottle at 5 to 35 °C / 41 – 95 °F. Protect from direct sunlight.

## Instructions for use

Select a standard with a conductivity value as close as possible to that of your solution. Be aware that conductivity standards pickup contaminates from the air/conductivity cell. Evaporation and dilution (water sticking to the cell) have a large effect on conductivity. Open the bottle for the minimum time required (the conductivity does remain within the specifications if the bottle is left open for maximum 1 hour in total). We recommend to calibrate in a clean chamber with the same size as the measuring chamber. Clean/rinse the conductivity cell thoroughly with distilled/deionized water before use. Shake the cell in order to remove any water droplets.

1. Pour approx. 50 mL of the standard into a clean calibration chamber (e.g. graduated glass cylinder) that has been rinsed with distilled/deionized water before use. Shake the cell in order to remove any water droplets.
2. Immerse the conductivity cell into this container and stir the solution with the cell.
3. Remove the cell and shake the cell to remove any droplets. Dispose the rinse solution.
4. Immerse the cell directly into the calibration chamber, filled with the conductivity standard. Immerse the cell to a sufficient depth. Check for air bubbles trapped within the cell. Stir the solution with the cell and move the cell up and down in the center of the solution. Take the reading when the solution is stagnant. Check the temperature reading and wait until temperature and conductivity reading have reached an equilibrium. This may require more than 5 minutes. Cells that were stored dry may require additional time to achieve stable readings. If you use a separate thermometer, make sure that it is clean and dry before it gets in contact with the calibration solution.

## Calibration

There are two possibilities to perform a calibration:

### Calibration at 25 °C

It is recommended to calibrate at 25 °C (international reference temperature).

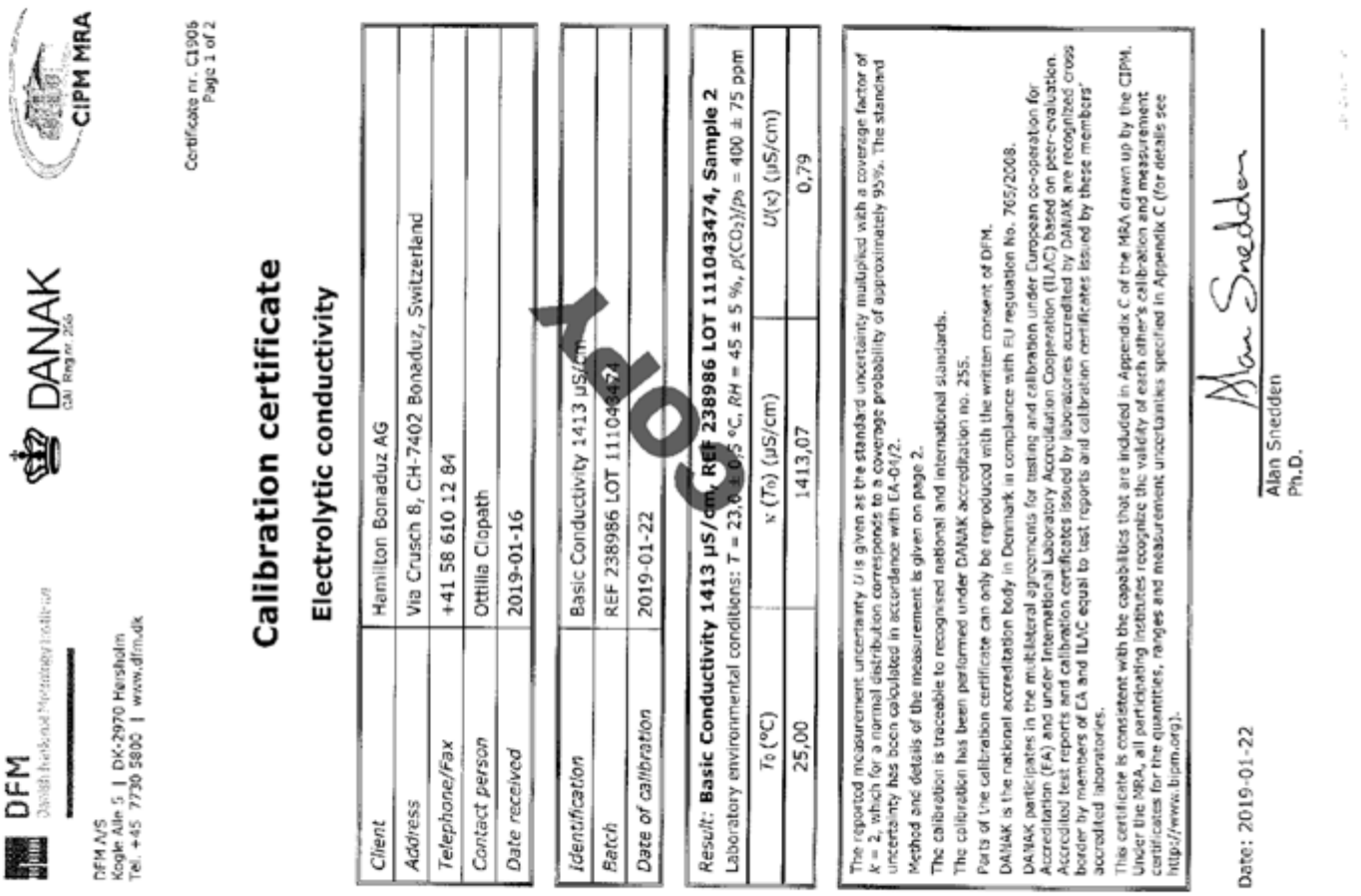
1. Turn off the temperature compensation of the instrument.
2. Wait until the temperature is 25 ± 0.1 °C and conductivity measurement shows a stable reading.
3. Adjust the cell constant to read the conductivity given in the certificate “actual value”.
4. Turn on the temperature compensation.

### Calibration at a temperature other than 25 °C

1. Turn off the instrument temperature compensation.
2. Read the temperature (wait for equilibrium).
3. Read the corresponding conductivity at that temperature from the temperature table (on the bottle). **Note:** the temperature table contains the nominal values which may differ slightly from the actual values.
4. Adjust the cell constant to read this conductivity (follow instrument instructions).
5. Turn on the temperature compensation.

## Temperature dependence

Conductivity is strongly influenced by temperature. To obtain the certified accuracy, temperature must be kept at a constant value ± 0.1 °C, preferably with a water bath.



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Tel. +45 7730 5800 | www.dfm.dk

DANAK
Cal Reg nr. 266

CIPM MRA

Certificate nr.: C1906
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**Calibration certificate**

**Electrolytic conductivity**

| | |
|---|---|
| *Client* | Hamilton Bonaduz AG |
| *Address* | Via Crusch 8, CH-7402 Bonaduz, Switzerland |
| *Telephone/Fax* | +41 58 610 12 84 |
| *Contact person* | Ottilia Clopath |
| *Date received* | 2019-01-16 |

| | |
|---|---|
| *Identification* | Basic Conductivity 1413 µS/cm |
| *Batch* | REF 238986 LOT 111043474 |
| *Date of calibration* | 2019-01-22 |

*Result:* **Basic Conductivity 1413 µS/cm, REF 238986 LOT 111043474, Sample 2**

Laboratory environmental conditions: $T$ = 23,0 ± 0,5 °C, $RH$ = 45 ± 5 %, $p(CO_2)/p_0$ = 400 ± 75 ppm

| $T_0$ (°C) | $\kappa$ ($T_0$) (µS/cm) | $U(\kappa)$ (µS/cm) |
|---|---|---|
| 25,00 | 1413,07 | 0,79 |

The reported measurement uncertainty $U$ is given as the standard uncertainty multiplied with a coverage factor of $k$ = 2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been calculated in accordance with EA-04/2.
Method and details of the measurement is given on page 2.
The calibration is traceable to recognised national and international standards.
The calibration has been performed under DANAK accreditation no. 255.
Parts of the calibration certificate can only be reproduced with the written consent of DFM.
DANAK is the national accreditation body in Denmark in compliance with EU regulation No. 765/2008.
DANAK participates in the multilateral agreements for testing and calibration under European co-operation for Accreditation (EA) and under International Laboratory Accreditation Cooperation (ILAC) based on peer-evaluation. Accredited test reports and calibration certificates issued by laboratories accredited by DANAK are recognized cross border by members of EA and ILAC equal to test reports and calibration certificates issued by these members' accredited laboratories.
This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see http://www.bipm.org).

Date: 2019-01-22

Alan Snedden
Ph.D.