Chloride Sealed Electrode AC018A

The Chloride electrode can be connected to the Nova5000, MultiLogPRO or TriLink data loggers.

The Chloride electrode is a PermaFil (non-refillable), Ion-selective electrode - the reference chamber is gel filled and sealed. No Reference Fill Solution is required. This electrode measures total free chloride in aqueous solutions simply, quickly, economically, and accurately.

The concentration range of the Chloride electrode is 1 M to 5 x 10^{-6} M or 1.8 ppm to 35500 ppm.

The Chloride electrode set (AC018A) consists of:

- PermaFil combination electrode (AC018), combining the Ion-selective electrode and the reference electrode in one
- Fourier's ISE amplifier (AC021)

Typical Experiments

Ion-selective electrodes are used in a wide variety of applications for determining the concentrations of various ions in aqueous solutions. The following is a list of some of the main areas in which Ion-selective electrodes have been used:

- Conducting water quality studies
- Determining the concentration of ammonium ions in aqueous solutions
- Pollution monitoring: CN, F, S, Cl, NO_3, etc. in effluents and natural waters
- Agriculture: NO_3, Cl, NH_4, K, Ca, I, CN in soils, plant material, fertilizers and foodstuffs
- Food processing: NO_3, NO_2 in meat preservatives
- Salt content of meat, fish, dairy products, fruit juices, brewing solutions
- F in drinking water and other drinks
- Ca in dairy products and beer

- K in fruit juices and wine making
- Measuring corrosive effect of NO_3 in canned foods
- Detergent manufacturing: Ca, Ba, F for studying effects on water quality
- Paper manufacture: S and Cl in pulping and recovery-cycle liquors
- Explosives: F, Cl, NO_3 in explosive materials and combustion products
- Electroplating: F and Cl in etching baths; S in anodizing baths.
- Biomedical laboratories: Ca, K, Cl in body fluids (blood, plasma, serum, sweat)
- F in skeletal and dental studies
- Education and research: Wide range of applications

How it Works

The Ion-selective Electrode (ISE) uses an Ion-selective membrane to allow only CL^{-} ions to penetrate the electrode. A potential drop is developed between the two sides of the sensing membrane. This potential is proportional to the logarithm of the concentration of the Chloride ion in accordance with the Nernst equation:

$$E = E_0 + S\log(a)$$

Where E is the measured voltage, E_0 is the reference potential, S is the slope and a is the Chloride activity. The slope is given by:

$$S = \frac{RT}{nF}$$

Where R is the gas constant, T is the temperature in Kelvin, n is the charge of the ion and F is the Faraday constant.

If the ionic strength is high and constant, the Nernst equation can be written as:

$$E = E_0 + S\log(C)$$

C is the Ionic concentration.

To adjust the background ionic strength to a high and constant value, the ionic strength adjuster (ISA) must be added to all samples and standards.

The potential develops due to the formation of a double layer consisting of a charged layer on the surface of the membrane of the ions sensed by the electrode and an opposite charged layer of counter ions from the sample (ions of opposite charge to the ones sensed by the electrode).

As with any measurement of potentials, all values are relative to the built-in reference electrode whose potential is constant. The reference solution aids in making electrical contact between the reference electrode (which is not in physical contact with the sample) and the sample. It consists of a solution of a salt that is able to conduct electricity but does not interfere with the measurement of the ion of interest.

Sensor Specification

Concentration Range:	1 M to 5 x 10^{-6} M or 1.8 ppm to 35500 ppm
Resolution (12-bit):	0.15 mV
pH Range:	2.0 to 12.0 pH
Temperature Range:	0 to 80 °C
Minimum Sample Size:	3 mL in a 50 mL beaker
Reproducibility:	± 2%
Default Sample Rate:	10 samples per second
Electrode Resistance:	Less than 1 MΩ
Interfering Ions:	CN^-, Br^-, I^-, OH^-, S^{2-}

Contents

- Combination CL^- Electrode (AC018)
- ISE amplifier (AC021)
- (1) 1 oz CL^- Ionic Strength Adjuster (ISA) (AJ0013)
- (1) 1 oz CL^- 10ppm as CL Standard (SD2053)
- (1) 1 oz CL^- 1000ppm as CL Standard (SD2012)

Required Equipment

- Nova5000, MultiLogPRO or TriLink data loggers
- Wash bottle with distilled or deionized water
- Several clean beakers
- 1 mL, 10 mL and 100 mL pipettes

Electrode Preparation

1. The Chloride electrode's sensing element comes pre-mounted on the end of the electrode with a protective bottle, but can be removed by unscrewing the electrode end. **Caution: Do not touch the PVC membrane with your fingers**.
2. Rinse the electrode with DI water, blot dry. **Do not rub dry.**
3. Place the electrode in the electrode holder. Immerse the tip of the electrode in DI water for 10 minutes, then a diluted Chloride standard solution for two hours prior to use.
4. Connect the electrode to the ISE amplifier.
5. Connect the ISE amplifier to the data logger's input.

Technical Notes

- Check the electrode every day when measurements are conducted.
- All standard solutions should be prepared fresh.
- Use ISA in all solutions.
- The standards should be at the same temperature as the sample.

Equipment Setup

1. Connect the electrode to the adaptor.
2. Connect the adaptor to the data logger's input.

Using the Chloride Electrode with Fourier Data Loggers and MultiLab Software

1. Launch the MultiLab software (from either your PC or Nova5000).
2. Connect the ISE amplifier to the data logger's first sensor input I/O-1.
3. The ISE amplifier is automatically recognized by the MultiLab software.
4. Click **Setup** on the main toolbar and program the data logger's sample rate and set the number of samples **Continuous**. Click **Run** on the main toolbar to start the measurement.

Checking Electrode Operation (Slope)

Check the electrode every day when measurements are conducted.

1. Connect the electrode to the ISE amplifier, and then connect the amplifier to the data logger.

2. Place 100 mL DI water into a 150 mL beaker. Add 2 mL ISA to the DI water and stir thoroughly.
3. Click **Run** to start the measurements.
4. Rinse the electrode with DI water, blot dry and place it in the solution prepared in step 2.
5. Pipette 1 mL of 1000 ppm Chloride Standard into the beaker. Stir thoroughly and then record the potential (E1) in mV when a stable reading is displayed.
6. Pipette 10 mL of the same standard into the same beaker. Stir thoroughly. When a stable reading is displayed, record the potential (E2) in mV.
7. Click **Stop** on the main toolbar.
8. The difference between the second and the first potential readings (E1-E2) is defined as the electrode slope. The normal range for the slope is 56 ±4 mV at 25 °C. The slope is defined as the change in potential observed when the concentration changes by a factor of 10.

Reading a Sample with the Electrode using Direct Calibration

Various procedures may be used to determine the concentration of a sample. The most common is the Direct Calibration method, which is described below.

In Direct Calibration a series of standard solutions of differing concentrations are used to calibrate the electrode. Then each sample requires only a single reading, which is compared with the calibration readings to obtain the sample concentration.

ISA is added to all solutions to ensure the samples and the standards have the same ionic strength.

Calibrate once a day before measurements.

Set up:

1. Prepare the electrode as described in *Electrode Preparation*.
2. Connect the electrode to the ISE amplifier, and then connect the amplifier to the data logger.
3. Prepare two standard solutions that differ in concentration by a factor of ten. The standards should be at the same temperature as the sample.

Measurement:

1. Place 100 mL of the more dilute standard into a 150 mL beaker. Add 2 mL of ISA and stir thoroughly.
2. Click **Run** to start the measurements.
3. Rinse the electrode with DI water, blot dry and place in the beaker. Wait for a stable reading, and then record the voltage reading.
4. Measure 100 mL of the more concentrated standard into a second 150 mL beaker. Add 2 mL of ISA and stir.
5. Rinse electrode with DI water, blot dry and place in the second beaker. Wait for a stable reading, and then record the voltage reading of the second standard.
6. On a semi-logarithmic graph paper, plot the voltage readings (linear axis) against the concentration (logarithmic axis). See Figure 1 for a typical calibration curve.
7. Pipette 100 mL of sample into a 150 mL beaker. Add 2 mL of ISA and stir thoroughly.
8. Rinse electrode with DI water, blot dry and place in the sample beaker. Wait for a stable reading and record the voltage reading.
9. Click **Stop** on the main toolbar.
10. Use the calibration curve to determine the sample's concentration.

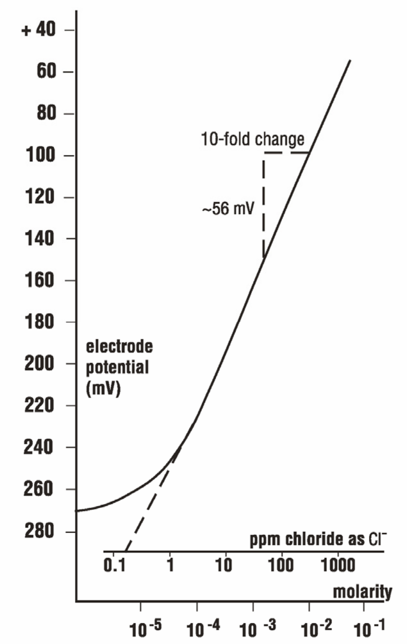

Figure 1: Typical calibration curve

Checking the Chloride Electrode Operation (Slope)

The graph below shows the difference between the potential drop between the two sides of the sensing membrane for 10 mL of 1000 ppm Chloride Standard and 1 mL of 1000 ppm Chloride Standard, which defines the slope of the calibration curve - 56mV.

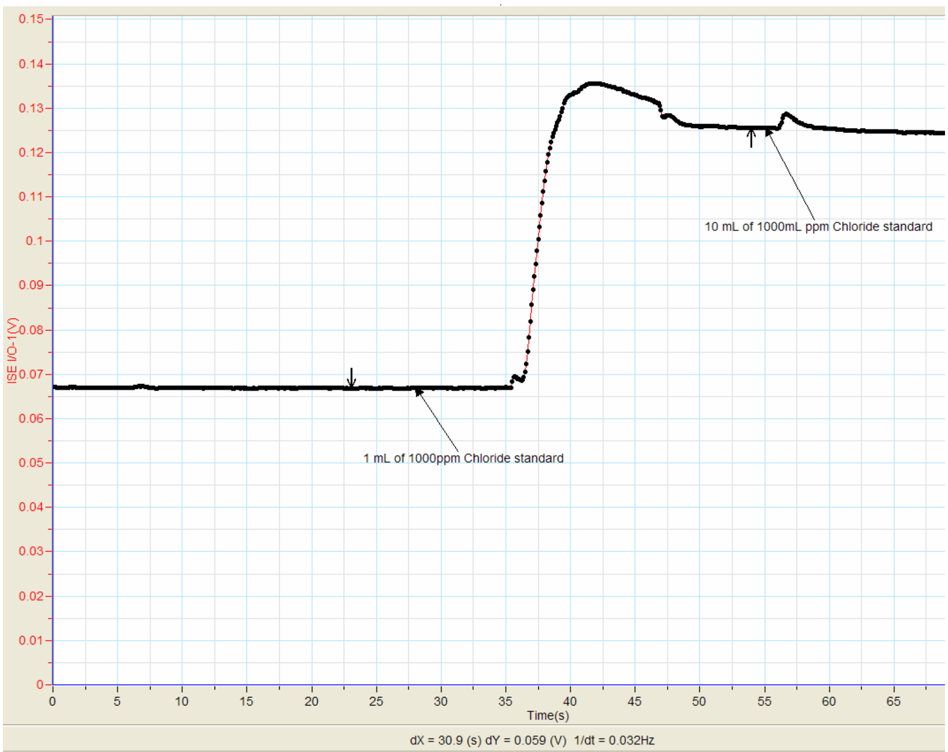

Figure 2: Chloride Electrode Slope

Maintenance and Electrode Storage

Short Term:

Rinse the electrode thoroughly with DI water and place the tip in a solution of 2 mL of ISA in 100 mL of DI water.

Long Term:

Rinse the electrode thoroughly with DI water and store dry. Replace the cap to protect the sensing element.

Follow procedures in *Electrode Preparation* and *Checking the Electrode Operation* when using the electrode again.

Troubleshooting

If the electrode slope is not within the normal range, the following procedure may restore the electrode.

1. Soak the electrode in the 10 ppm standard solution for two hours before use.
2. Repeat *Checking the Electrode Operation* procedure again.

Note: All standard solutions should be prepared fresh. Use ISA in all solutions**.**

Solutions

- 1000 ppm Cl (0.0282 M Cl):

Dissolve 1.648g NaCl in DI water and dilute to 1000mL

- ISA 5M NaNO3:

425g NaNO3 in 1000 mL DI water

Technical Support

Please contact Fourier technical support as follows:

Web: http://www.fourier-sys.com/support_support.html
Email: support@fourier-sys.com

Consult the FAQs before contacting technical support:

http://www.fourier-sys.com/support_faq.html

Copyright and Warranty

All standard Fourier Systems sensors carry a one-year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.

This Warranty does not cover breakage of the product caused by misuse or abuse.

This Warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.