IonX Portable Electrodes

BASIC CARE ITEMS

- Maintain the Electrode Solution level above the indicated black line (top-up using the supplied solution only - *item # 14635*).
- Keep the ceramic tip clean. Rinse off dirt and mud from the ceramic tip after each use.
- Replace the orange protective cap on the ceramic tip after each use (helps maintain the solution level).

For maximum reliability IonX portable electrodes must be returned to M. C. Miller Co. ***annually*** for recertification. The certification date is printed on the front box flap.

M. C. MILLER ELECTRODE CALIBRATION TEST

DERIVATION OF CALIBRATED ELECTRODE POTENTIAL VALUE

A specific test procedure is used for each manufactured reference electrode, regardless of the electrode type (Ag/AgCl or Cu/CuSO4).

The test procedure involves measuring the potential difference between a manufactured electrode and an Ag/AgCl Standard Electrode. The electrolyte that we use for the shop test is our facility's tap water (typical conductivity is 500µS/cm) and we keep the separation between the electrodes in the electrolyte "bath" at 2 inches. Also, the electrolyte temperature is maintained at 22°C, as are the solution temperatures in the manufactured electrodes and the "standard" reference electrode.

INTERPRETATION OF TEST DATA

Since the reference electrode used in the calibration test (Ag/AgCl electrode having a 4M KCl filling solution) has a half-cell potential of approximately 200mV versus a Standard Hydrogen Electrode (SHE), the half-cell potential of a manufactured electrode versus SHE becomes the test result **plus** 200mV.

For example, if a test result of 115mV is obtained from a copper/copper sulfate reference electrode, the electrode potential will be shown as, 315mV versus SHE, on the Calibration Certificate.

INSTRUCTIONS & MAINTENANCE

** IonX Portable Electrodes are shipped complete and arrive "ready-to-use." **

- Do not remove the ceramic tip, except when necessary to top off the filling solution as described below.
- Do not attempt to remove the (black) PVC component (top piece) from the (orange) Lexan tube. Unlike conventional portable electrodes, the copper rod assembly has not been designed to be removed from the Lexan tube. The rod assembly in the case of an IonX electrode is an integral part of a sealed unit.
- Store the electrode either right-side up (ceramic plug pointing down) or horizontally. Do not store the electrode upside-down (ceramic plug pointing up) – this prevents the ceramic plug drying out.
- Keep the Electrode Solution level inside the orange Lexan tube above the recommended minimum level [see below (procedure 1) for recommended level and explanation]
- Only use the M. C. Miller Electrode Solution (*item # 14635*) inside the orange Lexan tube. This solution has been specially formulated to satisfy several requirements, including having a specific electrolyte conductivity value.
- Keep the plastic cover over the ceramic plug when the electrode is not in use (reduces electrolyte (liquid) evaporation rate).
- **Do not use a ceramic tip that has been pre-soaked in copper sulfate solution** (such as the ceramic tip from a conventional portable electrode) as the Electrode Solution could become contaminated and this would also defeat a major purpose of the IonX electrode which is to eliminate operator (and soil) contact with toxic copper sulfate
- If the electrode has not been in use for some time and prior to embarking on a survey, it is recommended that after removing the plastic cover the ceramic tip be briefly run under tap water (or briefly dipped into a water source).
- If the soil surface is dry, wet the plug/soil contact area with water to provide better electrical contact.

AS NEEDED MAINTENANCE

How to "top-up" the solution inside the orange Lexan tube

The solution inside the orange Lexan tube is the "IonX Portable Electrode Solution" (*item # 14635*). Only this solution should be used to "top-up" the Lexan tube when necessary (see below).

The topping-up process should be done if the solution level (when the electrode is right-side up and in the vertical orientation) is below the level indicated by the black line drawn on the Lexan tube. Keeping the solution above this level will ensure that the internal plug is immersed in the solution, even with the electrode lying on its side (in the horizontal orientation).

First, turn the electrode upside down (ceramic tip on top) and unscrew the tip from the orange Lexan tube while holding the tube in an upright position. Next, add the solution to the Lexan tube, leaving 2 or 3 threads exposed (out-of-solution) at the top. Next, screw the ceramic tip back onto the Lexan tube (do not over-torque) and return the electrode to a normal orientation (tip pointing down, or electrode on its side) and let the electrode sit overnight prior to using the electrode to take readings.

Always keep the IonX Portable Electrode Solution inside the Lexan tube (at the correct level).

Ceramic tip replacement

If for any reason the ceramic tip must be replaced, the electrode should be returned to MCM for re-certification. **Field replacement could compromise the electrode's calibration value.**

Using an IonX electrode to check the calibration of a regular RE Series electrode

M.C. Miller's criterion which requires that the potential difference between two RE Series electrodes be less than ±5mV for a service electrode to be declared "calibrated" with respect to a non-service electrode, does not apply in the case of an IonX electrode.

IonX electrodes are pre-constructed and are supplied with a Certificate of Calibration. The electrode potential is quoted on the Certificate versus the Standard Hydrogen Electrode (SHE) potential. The electrode potential of an IonX electrode will be in the range, 316mV ±10mV versus SHE, which is the manufacturer's tolerance range for this type of electrode.

IonX electrodes are designed for field (service) use, however, if an IonX electrode is used to check the calibration of a regular RE Series electrode, an understanding of what a potential difference reading means in such a case, is required.

Example:

Let us say that an IonX electrode has an electrode potential, as indicated on its Certificate of Calibration, of 321mV versus SHE, which is a potential within the manufacturer's specified range. Now, let us say that a potential difference reading of 8mV is recorded in tap water between the IonX electrode and a service RE Series electrode. This means, in this example, that the potential of the service electrode is 313mV (321mV – 8mV) versus SHE, assuming that the IonX electrode was connected to the positive side of the voltmeter and the service electrode was connected to the negative side of the voltmeter.

Since the accepted electrode potential of a copper/saturated copper sulfate electrode is 316mV versus SHE, the service electrode potential in this example is within 3mV of the "Standard" value, which would be very acceptable (313mV compared to 316mV).

Consequently, the service electrode is "calibrated" in this example. However, since the potential difference between the IonX and the service electrode was measured

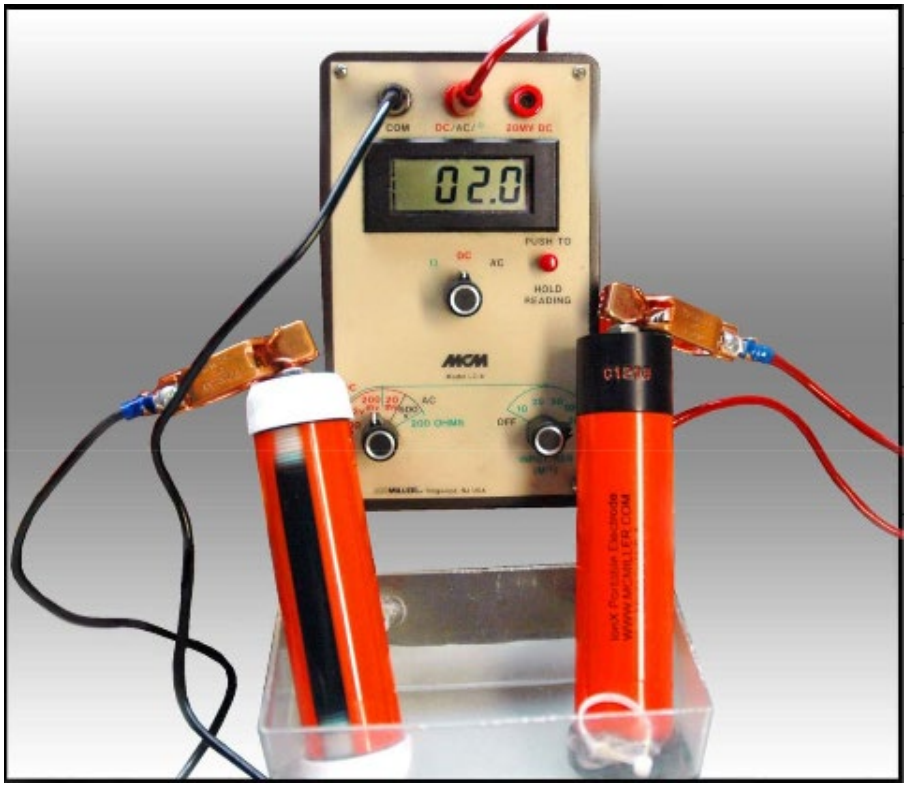
as 8mV, the service electrode would not have been declared calibrated by application of the ±5mV criterion.

So, if an IonX electrode is to be used to check the calibration of a service electrode, the first step is to check the electrode potential value quoted on its Certificate of Calibration, and based on the potential difference reading, determine the potential of the service electrode, and compare that value to the "Standard" 316mV value.

Example Test Set Up

An example calibration test set up is illustrated in the photograph below, which shows an example IonX electrode (Serial # C1218), together with a regular RE-5C electrode, with their ceramic tips immersed in tap water. The IonX electrode is connected to the positive side of the voltmeter and the regular RE Series electrode is connected to the negative side of the voltmeter.

Note: The solutions inside both electrodes should be allowed to stabilize to room temperature.



For this example, assume the electrode under test is filled with copper sulfate crystals and deionized/ distilled water and should have a nominal potential of 316mV vs SHE.

Since the IonX electrode potential was quoted as 318mV versus SHE on its Calibration Certificate, and, since the voltmeter reading (potential difference reading) was indicated as 2mV (see the LCD in the above photograph), the electrode potential of the RE-5C electrode, in this example, would be inferred to be 316mV versus SHE (318mV minus 2mV).

However, had the Calibration Certificate for the IonX electrode indicated an electrode potential of, say, 325mV versus SHE, the voltmeter reading would have been 9mV (rather than 2mV), in the case of this specific RE-5C electrode (325mV minus 9mV = 316mV).

However, if the electrode under test is filled with Antifreeze Solution or Gen II Gel, the potential shows a 12mV shift for a nominal potential of 328mV vs SHE.