M&D pH solutions *ground loops*

pH Readings Off The Mark?

A ground loop is defined as two or more electrically grounded points at different potentials. There may be no ground in the system or voltage/noise in the process. Symptoms include:

1. The analyzer reading is offset from the process reading by a consistent amount.
2. The analyzer reading is frozen on one value.
3. The analyzer reading is off the scale either up or down.

Common Causes Of A Ground Loops

Components, such as recorders or computers, connected to non-isolated analog outputs may cause a problem. Failure to install all shields properly, moisture or corrosion in a junction box are also common sources of ground loops. *Ground loops are usually attributed to the process or installation, rather than a fault in the instrumentation.* Once the sensor is out of the process the problem disappears – because the process or installation is providing the interference! Systematic troubleshooting is key:

1. Confirm There Is A Ground Loop

- Verify that the system measures buffers correctly, outside of the process.
- Then, connect a heavy gauge wire to the process piping, or place the wire in the tank. Place the other end of the test wire into the buffer cup with the pH sensor. This creates an electrical connection between the buffer cup and the process.
- If similar symptoms develop in the buffer cup, as were seen in the process, then the ground loop is confirmed. If no symptoms develop, then the ground loop is not confirmed, but it does not rule one out.

2. Verify Process Grounding

The pH electrode system needs one path to ground, and that path is through the process. Plastic piping, fiberglass tanks, ungrounded, or poorly grounded vessels do not provide this path. The system is therefore floating and is highly susceptible to any noise from stirrers, pumps, motors, etc.

- Ground the piping or tank to a local earth ground. Metal flow thru tees, ground rings, or grounding rods may be required.
- If the ground loop symptoms persist, then connect a wire from the GROUND at the DC Power Source to the transmitter's case, and then another wire from the transmitter's case to the process. These connections force all of the grounds to the same potential.
- If the problem persists, simple grounding is not the problem. There must be noise interference getting into the instrument. Try simplifying the pH sensor wiring, to reduce the possible noise paths.

3. Simplify the pH Sensor Wiring

- Retain the following sensor wire connections at the transmitter (if wired direct), or at the input side of the remote preamplifier if one is used: RTD SN, RTD IN, REF IN, pH/ORP IN.
- Remove the extra sensor wires, and tape the ends to keep them from shorting out. Next, connect a jumper wire between temperature compensation input terminals (usually RTDs). Connect an additional jumper wire between REF IN and SOL GND.
- Ensure that the sensor shields and inner drain wires do not touch grounded metal (insulate them to protect from contact with ground).
- Place the pH sensor back into the process. If the display is free of diagnostic messages, determine if the ground loop symptoms have been eliminated.
- Interpret Test Results. If the ground loop is gone, then the interference must have been coming into the instrument on one of the disconnected wires. The pH system can successfully operate with the simplified wiring on a permanent basis.

4. Disable Instrument Nuisance Alarms

Many analyzers have built-in diagnostics that may actually interfere with the troubleshooting process. Consult the instrument's instruction manual for steps about temporarily disabling these warnings.

5. Extra Ground Connections or Induced Noise

The electrode system is grounded through the process to earth ground. If an extra earth ground connection is made, then there are multiple paths and the classic ground loop symptoms are observed. The most common path for incoming interference is through the sensor cabling. The interference is either through a direct connection between grounded metal and one of the sensor leads or the noise (EMI/RFI) is being induced into the cable. Try running the sensor cable outside of its metal conduit, if applicable, (a shield may be exposed and touching metal inside the conduit).

- Place the sensor back in the process. If the ground loop symptoms are eliminated, then the interference likely came from a short between the sensor cable and the metal conduit. Repair any bare spots on the cable and carefully reinstall the cable in the conduit.

If the interference still exists, then the noise is possibly being induced into the cable or transmitter.

- To avoid induced noise into the sensor cable, re-route the pH sensor cable to avoid close proximity to power wires, motors, pumps, etc. Remove the sensor wiring from running through a crowded panel or move it outside of a cable tray.
- In rare instances, noise has been induced into the transmitter's metal housing by the metal that it is mounted on. Noise that gets onto the transmitter's metal housing will be radiated into the electronics boards. Try removing the transmitter housing from its metal mounting and isolate it. If this technique resolves the interference, then remount the transmitter in a different location, or mount it with isolating materials.

New Problem On An Older System?

Ask, what changed in the process recently?

- Remember, water conducts electricity. Check terminal connections for moisture. Take steps to insulate against leaks into the enclosure. Replace old gaskets and junction boxes as necessary. More questions on troubleshooting?

Considering replacing your older system? *We can help you. Call Murphy & Dickey at 630.655.1080.*

Murphy & Dickey, Inc.
930 N. York Road # 205
Hinsdale, IL 60521
630-655-1080 phone
630-655-1085 fax
sales@murphyanddickey.com

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