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W100/W600/W900 Controller
pH Electrode Troubleshooting Guide

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Note: pH electrodes are like batteries and their output voltage will change with time, even if they are not being used. The useful life of a pH electrode is limited, and that time varies with the conditions it's exposed to in the application. Electrode life may be as short as one week in some aggressive applications (extreme temperature, pH and/or pressure, dirty water, harsh chemicals) or more than a year in other applications with potable quality water at room temperature.

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This Troubleshooting Guide covers pH electrode troubleshooting whether the electrode is connected to the **WEL-PH Housing** or to the **WEL Transmitter Housing**.

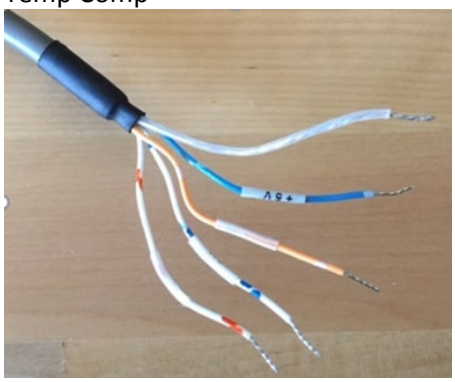
- The **WEL-PH Housing** is a direct sensor input, which means it wires into the controller sensor input terminals.
  - The **WEL-PH Housing** works with the W100, W600 and W900 controllers.
- The **WEL Transmitter Housing** is an analog input, which means it wires into the controller analog input terminals.
  - The **WEL Transmitter Housing** only works with the W600 and W900 controllers, not with the W100 controller.

You can determine which configuration you have based on the following.

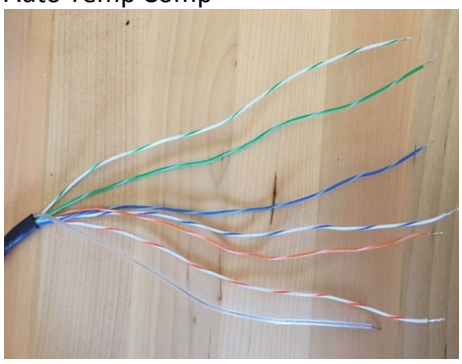
The **WEL-PH Housing** and the **WEL Transmitter Housing** will look physically identical. To tell them apart, please look at the end of the sensor cable (that will connect to the controller).

The **WEL-PH Housing** will have either 4 (No Automatic Temperature Compensation) wires, or 6 wires (Automatic Temperature Compensation), plus a shield wire.

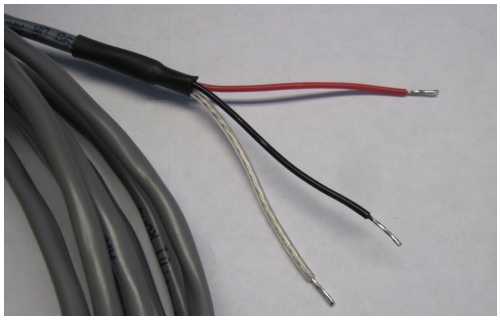
4 wire WEL-PH Housing plus shield, no Auto Temp Comp



6 wire WEL-PH Housing plus shield, has Auto Temp Comp



The **WEL Transmitter Housing** will have 2 wires plus a shield wire. The Auto Temp Comp is built into the housing.



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Section 1: Electrode Reading Responds Slowly

Step 1:

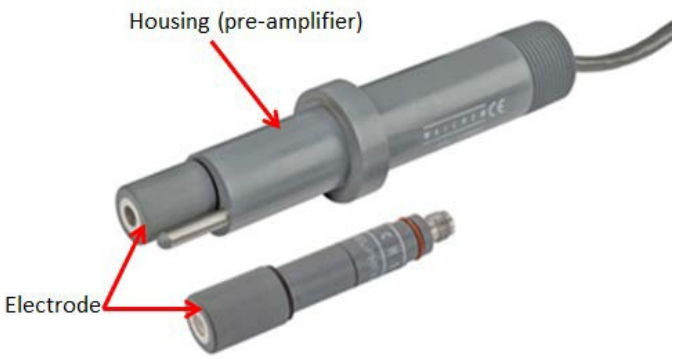
pH electrodes require periodic cleaning and calibration.

- The method of cleaning the electrode will depend upon the coating, as well as the materials of construction of the electrode. Do not use a solvent that will attack the electrode.
- Oily coatings should be removed with a mild detergent or isopropyl alcohol.
- Hard scales such as calcium carbonate can usually be removed with a dilute hydrochloric acid solution.
- Soft coatings can be removed using a soft cloth or soft toothbrush.
- A two-point calibration should always be performed after cleaning the electrode.

Step 2:

If cleaning does not speed up the electrode's response

- Replace the electrode.



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Section 2 (A): WEL-PH Housing + Electrode Reading is Stuck on one Value

Step 1:

The following are normal (expected) readings when the controller electrode input is programmed as pH, and the following configurations are in place:

- With nothing connected to the electrode input terminals in the controller, the reading should be about 0 mV (7 pH).
- With just the WEL-PH housing wired into the electrode input terminals in the controller (but no electrode installed), the reading should float (vary low to high to low to high, etc.).
- With the WEL-PH housing wired into the electrode input terminals in the controller, and the electrode threaded into the housing, the reading should be the pH value of the solution, as verified by a secondary means, such as a handheld pH meter.

Step 2:

If a controller's electrode input is programmed as pH, and the controller has a WEL-PH housing wired into the correct electrode input terminals (with the electrode threaded into the housing), and the pH reading is stuck on some incorrect pH value, please check the following:

- There could be an electrical short between controller input terminals IN+ and IN-
  - Either the electrode wires, or electrode cable wires, are contacting each other when they normally should not be.
- The glass on the end of the electrode could be broken or compromised.
- There is an open circuit between controller input terminals IN+ and IN-
  - This could mean the electrode/electrode cable has broken wires.

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Section 2 (B): WEL Transmitter Housing + Electrode Reading is Stuck on one Value or Reading Erratically

Note: This section is applicable to W600 and W900 controllers (not applicable to W100 controllers).

The WEL Transmitter housings are:

- For use with ORP electrodes (cartridges), with a 4-20 mA range scaled to -500 to 1000 mV.
- The other has automatic temperature compensation (measured by an RTD) for use with pH electrodes (cartridges), with a 4-20 mA range scaled to 0 to 14 pH standard units.
    - Note: The WEL Transmitter Housing + pH Electrode will output a 4-20mA signal only, there will not be a separate temperature reading sent to the controller. Automatic temperature compensation takes place inside the WEL Transmitter Housing.

The following are normal (expected) readings when the controller electrode input is programmed as pH, and the following configurations are in place:

- With nothing connected to the analog input terminals in the controller, the reading should be about 0 mV (7 pH).

- With just the WEL Transmitter housing wired into the analog input terminals in the controller (but no electrode installed), the reading should float (vary low to high to low to high, etc.).

- With the WEL Transmitter housing wired into the analog input terminals in the controller, and the electrode threaded into the housing, if the RTD (automatic temperature compensation) fails in the open position (wires somehow disconnected inside the housing) the reading should be stuck at 0mV (7pH).

- With the WEL Transmitter housing wired into the analog input terminals in the controller, and the electrode threaded into the housing, if the RTD (automatic temperature compensation) fails in the closed position (wires somehow shorted inside the housing) the reading should float (vary low to high to low to high, etc.).

- With the WEL Transmitter housing wired into the analog input terminals in the controller, and the electrode threaded into the housing, if the glass on the end of the electrode breaks, the reading should be a constant 12.0 mA (7pH).

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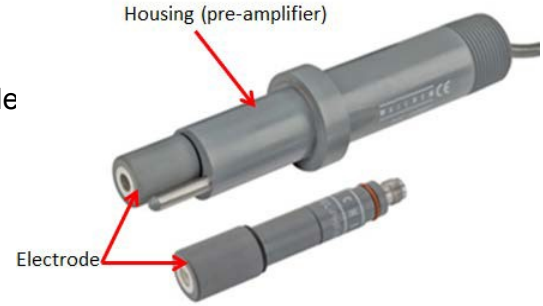
Section 3 (A): WEL-PH Housing + Electrode Reads Low or High Versus a Calibrated Handheld Meter; Cannot Calibrate the Electrode

Step 1:

pH value versus mV reading



- This menu displays the mV measured by the electrode For every pH unit above 7, the mV value should change by about –59 mV. For every pH unit below 7, the mV value should change by about +59 mV.

Step 2:

- pH and temperature relationship
  - pH electrodes can be ordered with Automatic Temperature Compensation (ATC), or not.
  - If the pH electrode comes with ATC:
    - Look for the temperature leads from the electrode housing
    - Usually they are green and white/green leads.

- If the pH electrode has ATC, the next step is to verify the controller has the correct temperature element programmed into the Temperature Input menu, and it is reading the correct temperature. Typically, temperature element = RTD1000 Ω for Walchem pH electrodes.

- Temperature element:
  - Some electrodes do not have ATC. If you are not using ATC, in the Inputs menu/Temperature/Settings, scroll to Element, and select No Element. And whatever the water sample temperature is, set that as the Default Temperature in the pH Input menu.
  - If the electrode you are using has ATC, and if the temperature reading is the problem, there is a resistance reading that correlates to the temperature reading. From the controller touchpad, you can check the resistance reading in the Inputs menu/Temperature section. The resistance reading should be 1000 ohm + 3.85 ohms per degree C above 25C. Below is how the math works. If the resistance reading in the controller matches (or is very close to) the math below, then the electrode temperature element and the controller are not the issue.

- The 1000 Ω RTD has a resistance of 1000 ohms at 0C (32F). And the resistance goes up by 3.85 ohms per degree C. Here are some examples:

  - At 25C it should read 1000 + (25 * 3.85) = 1000 + 96.25 = 1096.25 ohms.
  - At 50C it should read 1000 + (50 * 3.85) = 1000 + 192.5 = 1192.5 ohms.
  - At 100C it should read 1000 + (100 * 3.85) = 1000 + 385 = 1385 ohms.
  - At 150C it should read 1000 + (150 * 3.85) = 1000 + 578 = 1578 ohms.
  - At 180C it should read 1000 + (180 * 3.85) = 1000 + 693 = 1693 ohms.

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Section 3 (A): WEL-PH Housing + Electrode Reads Low or High Versus a Calibrated Handheld Meter: Cannot Calibrate the Electrode (continued)

- If the resistance reading is incorrect, disconnect the WHITE/GREEN wires from the terminal strip inside the controller and using a multimeter, set to resistance (ohms), measure the resistance across the WHITE/GREEN and GREEN/WHITE wires coming directly from the electrode. Reading should be 1000 ohm + 3.85 ohms per degree C above 0°C. If reading is incorrect, the temperature element in the electrode is bad. If the resistance reading is good, yet it still displays the temperature incorrectly, the problem is with the controller front panel.

- If the problem is the controller front panel, please contact your supplier of Walchem equipment.

Step 3:

- Calibration fails

    - In the controller's pH Electrode Input menu, look at the pH Raw Value and the Gain Value.

    - What is the calibration range that you are allowed to go to?
        - The controller shows us a current pH reading and a raw pH reading.
        - This raw value is in mV units.
        - The range (referred to as gain) that the controller will allow you to calibrate to uses the raw pH as a reference point.
        - Gain is a value that the controller calculates, and it tells us how far you are calibrating from the raw pH value.
        - For pH electrodes, the calibration will fail if the adjustment to the gain is outside of the 0.2 to 1.2 range, or if the calculated offset is outside of -140 to +140mV.
            - What is Offset?
            - Offset = this is the mV value that the pH electrode is measuring at pH=7
            - Normal offset at pH=7 should be approximately +/-10mV
            - The controller software allows this range to be -140 to +140mV

- To re-establish a starting point, the controller allows you to reset the calibration values as follows:
    - Go to the pH Electrode Inputs menu. Press the Settings key, then the Down arrow until you see Reset Calibration Values. Press on the Reset Calibration field, and then press the Check mark to accept.
    - You should now perform a pH electrode calibration in accordance with the controller manual.

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Section 3 (B): WEL-Transmitter Housing + Electrode Reads Low or High Versus a Calibrated Handheld Meter; Cannot Calibrate the Electrode

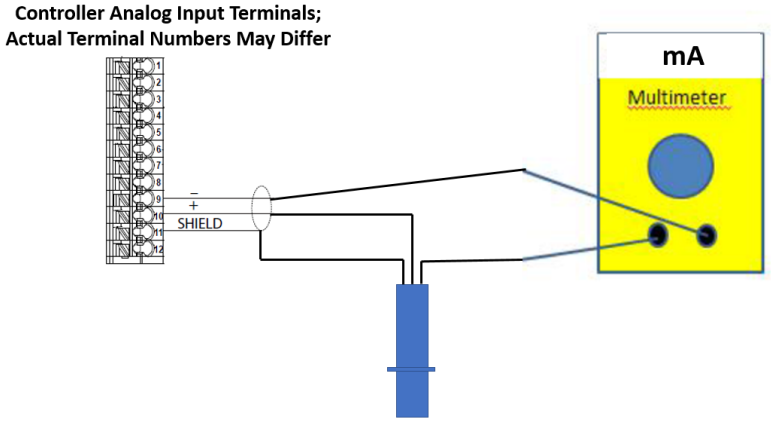
pH value versus mA reading

- The pH analog input menu displays the mA measured by the electrode, with a 4-20 mA range scaled to 0 to 14 pH standard units. As a reference, please see the table below. However, these reference points may change subsequent to calibration.

mA	pH
4	0
12	7
20	14

- If the pH (mA) reading is not correct, using a multimeter, please check the mA signal coming from the sensor and into the controller as follows:

  - Place the WEL Transmitter Housing plus Electrode in the system tee/water, or place it in a buffer solution.
  - Power down the controller. Disconnect either the red or the black sensor lead (not the shield wire) and connect a multimeter in series as shown below to measure current (mA)
  - Power up the controller. The multimeter will display the mA going to the controller from the sensor.
    - If the mA value is stuck on one value, no matter if the sensor is in the system tee/water or in different buffer solutions, then please refer to **Section 2B** in this guide.
    - If the mA value differs from the from the chart above, please perform a One point or Two Point calibration in accordance with the controller manual.



WEL-Transmitter Housing plus Electrode should be in the system tee/water, or in a buffer solution

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Section 4: WEL-PH Housing + Electrode (Sensor) Fault

Step 1:

- Electrode Fault
  - This error indicates that the signal from the electrode is no longer valid at all. This error condition with stop control of any output using the electrode.

Possible Cause	Corrective Action
Electrode wires shorted	Disconnect short
Faulty electrode	Replace electrode
Faulty controller	Replace or repair controller

- Controller, Power, Display, or Electrode Board Error
  - This alarm occurs if the board listed is not recognized.

Possible Cause	Corrective Action
Poor ribbon cable connection	Remove and reseat ribbon cable, cycle power
Poor option card connection (not applicable to W100)	Remove and reseat the board, cycle power
Faulty board	Replace or repair controller

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Section 5: WEL-PH Housing + Electrode OR WEL Transmitter Housing + Electrode Reading is Unstable

Step 1:

The pH reading is unstable when the pH electrode is placed in the system water.

- Remove the pH electrode from the system water and place it in a beaker of water. Does the reading stabilize? If yes, then proceed to **Step 2**. If no, proceed to **Step 3**.

Step 2:

The electrode is still in the beaker of water, and the reading is stable.

- Obtain a length of wire (the ends of the wire must be stripped) long enough to place one end in the water in the beaker, and the other end in the system water.
- With this length of wire connecting the beaker water to the system water, does the reading stay stable?
- If the reading does not stay stable, this can indicate a ground loop. A ground loop could cause readings to be stuck at a high or low value. Or there is some electrical interference in the system water, possibly from a mixer, recirculation pump, etc. Removing power from each device and checking to see if the reading stabilizes can help determine the source of the electrical interference.

Step 3:

The electrode is still in the beaker, and the reading is still unstable.

- Power down the controller, disconnect the pH electrode shield wire from the Earth ground stud inside the controller.
- Does the reading stabilize?
- If the reading stabilizes, then there is possibly some electrical noise coming in through the controller VAC mains.
- If the reading does not stay stable, then connect the controller to an alternate supply voltage circuit. This may necessitate temporarily running an extension cord for this test. If the reading still does not stay stable, please contact your supplier of Walchem equipment for further instructions.