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Troubleshooting WBL100, WBL600 and WBL900 Controllers

Scope

This document is a guide for troubleshooting conductivity reading/calibration problems in WBL100, WBL600 and WBL 900 boiler controllers.

Programming

Controller Inputs:

In the Inputs menu / Temperature / Settings, scroll to Element, and select the specific type of temperature sensor to be connected. For boiler conductivity sensors it is RTD 1000 Ω (ohms), or if the sensor does not have Automatic Temperature Compensation (ATC), then under Element select No Element.

In the Inputs menu / Conductivity Sensor / Settings, scroll to Cell Constant, and make sure the correct cell constant, it is usually 1.0 or 10.0 for boiler applications.

Here is a list of the boiler conductivity sensors that would be included in the boiler controller model number.

Boiler	Description	Cell Constant	Temp Element
191694	Boiler sensor with ATC, 250 psi, ¾"NPT	1.0	RTD 1000
191695	Boiler sensor without ATC, 250 psi, ¾"NPT	1.0	No Element
191696	Boiler sensor with ATC, 250 psi, ¾"NPT	10.0	RTD 1000

Here is a list of alternate conductivity sensors that you may have selected to use with your boiler controller.

Contacting Conductivity Sensors			
Part Number	**Description**	**Cell Constant**	**Temp Element**
103903-10	Sensor, Contacting Conductivity, no gland, 10 ft cable	0.01	RTD 1000
103904-10	Sensor, Contacting Conductivity, no gland, 10 ft cable	0.1	RTD 1000
103905-10	Sensor, Contacting Conductivity, no gland, 10 ft cable	1.0	RTD 1000
103906-10	Sensor, Contacting Conductivity, no gland, 10 ft cable	10.0	RTD 1000

Note: The above sensors will require one of the following glands based on temperature and pressure.

Part Number	Description	Pressure	Temperature
191669	Gland, steel, 1/2" NPT, 200 psi, for 103903-103906 sensors	0-200 psi	32-248° F
103907	Gland, PP, 1/2" NPT, 100 psi, for 103903-103906 sensors	0-100 psi	32-212° F

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Programming

Controller Outputs:

In the Outputs menu / Relay / Settings:

- Scroll to Input and please make sure the relay is mapped to the correct sensor.
- Scroll to Mode and please make sure the correct mode is selected.
  - On/Off mode for Continuous Sampling, or
  - Int Sampling for Intermittent Sampling
  - Note: Make sure that the Mode you select matches the blowdown plumbing configuration, either Continuous Sampling or Intermittent Sampling. These plumbing configurations are shown in the controller manual.
- Scroll to Interlock Channels and please make sure the correct interlocks are checked off, if needed.
- Scroll to HOA and please make sure the relay is programmed for Auto.

Calibration Fail

The calibration will fail if the adjustment to the gain is outside of 0.5 to 2.0. This is a comparison between the current conductivity value and the raw conductivity value. These values are shown in the Inputs menu / Conductivity.

For example: The current conductivity is 4000uS and the raw conductivity is 18,000 uS, why so far apart? If you divide 4000 by 18,000 you get .22 and that's the temperature multiplier in this application as shown in our conductivity brochure (please see the chart below). That means the boiler sample water temp should be about 180C. So unlike the other controllers, the raw and current conductivity readings can be far apart, but related by the temp range multiplier.

Temperature °C	0	10	15	20	25	30	35	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
Range Multplier %	181.3	139.9	124.2	111.1	100.0	90.6	82.5	75.5	64.3	55.6	48.9	43.5	39.2	35.7	32.8	30.4	28.5	26.9	25.5	24.4	23.6	22.9

Note: Conductivity ranges above apply at 25°C. At higher temperatures, the range is reduced per the range multplier chart.

The range that the controller will allow you to calibrate to (referred to as gain in the W100/W600), uses the raw conductivity as a reference point. Gain is a value that the controller calculates and it tells us how far you are calibrating from the raw conductivity value.

The calibration will fail if the adjustment to the gain is outside of 0.5 to 2.0.

Possible Cause	**Correction Action**
Dirty sensor	Clean sensor
Improper wiring of sensor to controller	Correct wiring
Wrong cell constant	Program correct cell constant in controller
Incorrect temperature reading or setting	Ensure that the temperature is accurate
Incorrect cable length or wire gauge setting	Set to correct values
Faulty sensor	Replace sensor
Faulty controller	Replace or repair controller

Troubleshooting

1) Try cleaning the electrode first.
   a. If necessary, clean the sensor using a dilute acid until it stops fizzing. Reinstall and check reading. See the end of this document for additional cleaning procedures.
   b. If the conductivity reading is still low or unstable, flashing is the likely cause.

2) To check for flashing, close a valve downstream of the sensor. If the reading climbs and stabilizes over the next several minutes, then the sample is flashing.

   a. To correct, verify that the sensors are installed in the blowdown line as per Walchem recommendations (see diagrams in instruction manual).

   b. Make sure the minimum water level in the boiler is at least 4-6 inches above the skimmer blowdown line. If the skimmer line is closer to the surface, it is likely that steam will be drawn into the line instead of boiler water. The skimmer line must also be installed above the highest tube.

   c. Maintain a 3/4-inch minimum pipe ID with no flow restrictions from the tap for the boiler skimmer blowdown line to the sensor. If the ID is reduced below 3/4 inch, then flashing will occur beyond that point and the conductivity reading will be low and erratic. Minimize the usage of tees, valves, elbows or unions between the boiler and the sensor.

   d. A manual shut off valve should be installed so that the sensor can be removed and cleaned. This valve must be a full port valve in order to avoid a flow restriction.

   e. Keep the distance between the tap for the boiler skimmer line to the sensor as short as possible, to a maximum of 10 feet.

   f. Mount the sensor in the side branch of a ¾ ”cross in a horizontal run of pipe (see diagram in manual). This will minimize entrapment of steam around the sensor and will allow any solids to pass through. DO NOT INSTALL USING A REDUCING BUSHING IN A 1” OR LARGER CROSS.

   g. There MUST be a flow restriction after the sensor and/or control valve in order to provide backpressure. This flow restriction will be either a flow control valve or an orifice union. The amount of the flow restriction will affect the blowdown rate as well, and should be sized accordingly.

   h. Install the motorized ball valve or solenoid valve per the manufacturer’s instructions.

   i. For best results, align the hole in the conductivity sensor such that the direction of water flow is through the hole.

3) If the sensor is clean, the sample is not flashing, the plumbing is correct, but the conductivity is not reading properly, perform the following steps:

   a. Remove the sensor and place in a beaker of boiler water with a known conductivity value. If the controller is in an Intermittent Sampling mode, go to the Intermittent Sampling relay menu and the conductivity value displayed responds to changes.

   b. If the conductivity reading matches the sample, connect a wire between the beaker of water and the pipe (skimmer line). If the value changes (usually lower), there is a ground loop and there may be a problem with the sensor wiring, front panel, or option card. Contact the factory for assistance.

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Other Checks

Wiring:
Verify that all sensor wiring is correct as shown in the instruction manual. The cable must be shielded from background electrical noise. Assure that all connections are good and that the cable shield wire is terminated only on one end, and that is to the SHIELD terminal inside the controller (the shield must not be connected in the sensor junction box). Sensor cables must not be in the same conduit as AC power and always route low voltage (sensor) signals with at least a 6" (15 cm) separation from AC voltage wiring. The conductivity sensor should be placed as close to the controller as possible, to a maximum distance of 250 ft. (76 m) Less than 25 ft (8 m) is recommended.

Temperature element:
Some sensors do not have automatic temperature compensation, ATC. If you are using these, in the Inputs menu / Temperature / Settings, scroll to Element, and select No Element. And whatever the boiler water sample temperature is, set that as the Default Temperature in the Conductivity Input menu.

If the sensor you are using has ATC, and if the temperature reading is the problem, there is a resistance reading that correlates to the temperature reading. 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 sensor 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.

If the resistance reading is incorrect, disconnect the WHITE and GREEN wires from the terminal strip in the junction box and measure across the WHITE and GREEN wires coming directly from the sensor. Reading should be 1000 ohm + 3.85 ohms per degree C above 0°C. If reading is incorrect, the temperature element in the sensor is bad. If this reading is good, reconnect at the terminal strip in the junction box, and disconnect at the controller end and check the reading between WHITE and GREEN wires. If the resistance is good, yet it still reads incorrectly, the problem is with the controller front panel or option card.

Sensor leaking:
Occasionally the sensor could leak boiler water into the internals of the sensor. Carefully examine the sensor and junction box for signs of leakage.

Grounding issues:
Even though all wiring may be properly installed, a potential problem with the controller ground may be the cause of the calibration problem. Have a qualified electrician check to see if the power panel the controller is connected to is properly grounded. Removing the sensor from the process and placing overnight in a beaker of standard solution can also verify this. If the reading drifts, improper grounding of the controller may be the problem. If it does not drift, the process itself may be poorly grounded.

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Summary:

Sensor Fault

This error indicates that the signal from the sensor is no longer valid at all. This error condition will stop control of any output using the sensor.

Possible Cause	Correction Action
Sensor wires shorted	Disconnect short
Faulty sensor	Replace sensor
Faulty controller	Replace or repair controller

Conductivity Reads Too Low And/Or Unstable

Possible Cause	Correction Action
Improper wiring of sensor to controller	Correct wiring
Steam flashback	Correct plumbing
Steam carryover	Correct boiler water level or skimmer line
Sensor not completely submerged	Use ¾" tee; do not use 1" tee with bushing
Faulty sensor	Replace sensor
Faulty controller	Replace or repair controller

Conductivity Reads Too High

Possible Cause	Correction Action
Sensor wires shorted	Disconnect short
Dirty sensor	Clean sensor
Faulty sensor	Replace sensor
Faulty controller	Replace or repair controller

High Temperature Contacting Conductivity Sensor Cleaning

The frequency of cleaning for the contacting conductivity electrode varies with each installation. The best way to determine the frequency is to compare the reading of the controller to the reading of a calibrated hand held instrument. When the two readings differ by an amount that you deem to be excessive (perhaps 5%), then it time to clean and recalibrate the electrode. The frequency should be every 2-3 months or so.

To clean the high temperature contacting conductivity electrode, close the isolation valve(s) to stop sample flow. Open the manual blowdown bypass valve to relieve the pressure in the piping. Remove the electrode from the pipe.

For removal of scale, dip in a dilute hydrochloric or gallic acid solution, and rinse.

For oils (including fingerprints!) wash with a detergent.

Replace the electrode in the pipe. Note that the sensor should be placed with the hole facing the direction of flow. Open the isolation valves and inspect for leaks. After cleaning, it is necessary to recalibrate the electrode. This is only accurate when the electrode is installed in the piping.