

1. OBJECTIVE

Details the causes, symptoms and fixes for controller boiler conductivities, which do not track actual, measured boiler conductivity.

See the last page of this application note if you are commissioning a new controller installation.

2. CONDUCTIVITY TRACKING

An accurate conductivity measurement requires that:

1. The conductivity sensor is fully and continuously immersed.
2. The conductivity sensor is heated to the boiler saturated steam temperature during the sensor Sampling period.
3. The blowdown valve closes and seals during the Wait-To-Measure period.
4. The boiler operates at constant pressure since pressure sets the saturated steam temperature.
5. The boiler water sample used for controller calibration is collected from the same pipe as the sensor and the sample is not a flashed sample.

If any one of the previous five requirements are not met, conductivity will not measure correctly; and the controller conductivity will not match the boiler conductivity.

3. MEASUREMENT ERROR SOURCES & FIXES

Requires that the conductivity sensor is fully and continuously immersed.

CAUSE

¾" NPT conductivity sensors installed vertically in horizontal 1" 'T's in low pressure boilers will measure partially in the vapor space.

A boiler water level which drops below the surface blowdown line will mix steam & water in the blowdown line. More common in older boilers, faulty water level controls and/or sites with carry-over.

SYMPTOM

Measured conductivity will vary from sample-to-sample as the water-steam mix
Boilers with carryover will foul sensors. Calibration will show increasing gains; visible inspection will show sensor deposits,

FIX

Depending on fault: Re-plumb, Correct boiler controls or suppress carry-over

Requires that the conductivity sensor is heated to the boiler saturated steam temperature during the sensor sampling period.

CAUSE

Temperature compensation of conductivity requires that the sensor be at the same temperature at the end of every Sample period so that a fixed and repeatable amount of cooling occurs during the Wait-To-Measure period.

The effect of temperature conductivity is 1% per degree F. A 25F difference between samples causes a 25% error in conductivity measurement.

Sampling times less than 30 seconds can cause problems if the throttling orifice is set too small to clear the pipe run to the sensor

SYMPTOM

Frequent re-calibration. High sensor gains reflecting a low temperature sensor.

Sensor GAIN numbers fall as one calibration immediately follows another with sensor reflecting residual heat from the first calibration.

FIX

Measurement error due to varying sensor temperature is more likely with sensors located 40-100ft from the boiler. These sensors require both longer sampling times to clear the sampling line and wider throttling valve settings.

Always calibrate sensors at boiler operating pressure.

If in doubt about sensor temperatures, use an IR thermal gun to verify the sensor 'T' achieves the saturated steam temperature during sampling.

Don't set the blowdown time lower than the sample time is sensor heating is marginal.

Requires that the blowdown valve, closes and seals during the wait-to-measure period.

CAUSE

Temperature compensation of conductivity requires that the sensor cool during the wait-to-measure period. If the blowdown valve or solenoid does not seal, varying rates of sensor heating will continue; depending on the amount of boiler temperature water passing the valve seal.

SYMPTOM

Frequent re-calibration. Low sensor gains reflecting a non-cooling sensor. Sensor GAIN numbers are not repeatable between calibrations as the rate of sensor cooling varies with the volume of water passing the valve seat.

Remove the controller blowdown interlock to prevent sampling & blowdown. Wait 45-60 minutes. If the piping downstream of the valve is still >200F, steam is bypassing the valve seals.

This fault is much more common with solenoids than motorized valves.

FIX

Repair valve or solenoid. Clean seating surfaces.

Requires that the boiler operates at constant pressure since pressure sets the saturated steam temperature.

CAUSE

The effect of temperature conductivity is 1% per degree F. A 25F difference between samples causes a 25% error in conductivity measurement. This error is roughly the difference is saturated steam temperature between 100psi & 150psi.

SYMPTOM

Controller displays lower conductivity while boilers coming up to operating pressure.

FIX

Typically none required since blowdown is not usually required during start-up.
Do not calibrate boiler sensors until boiler has reached operating pressure.

Requires that the boiler water sample used for controller calibration is collected from the same pipe as the sensor and the sample is not a flashed sample.

CAUSE

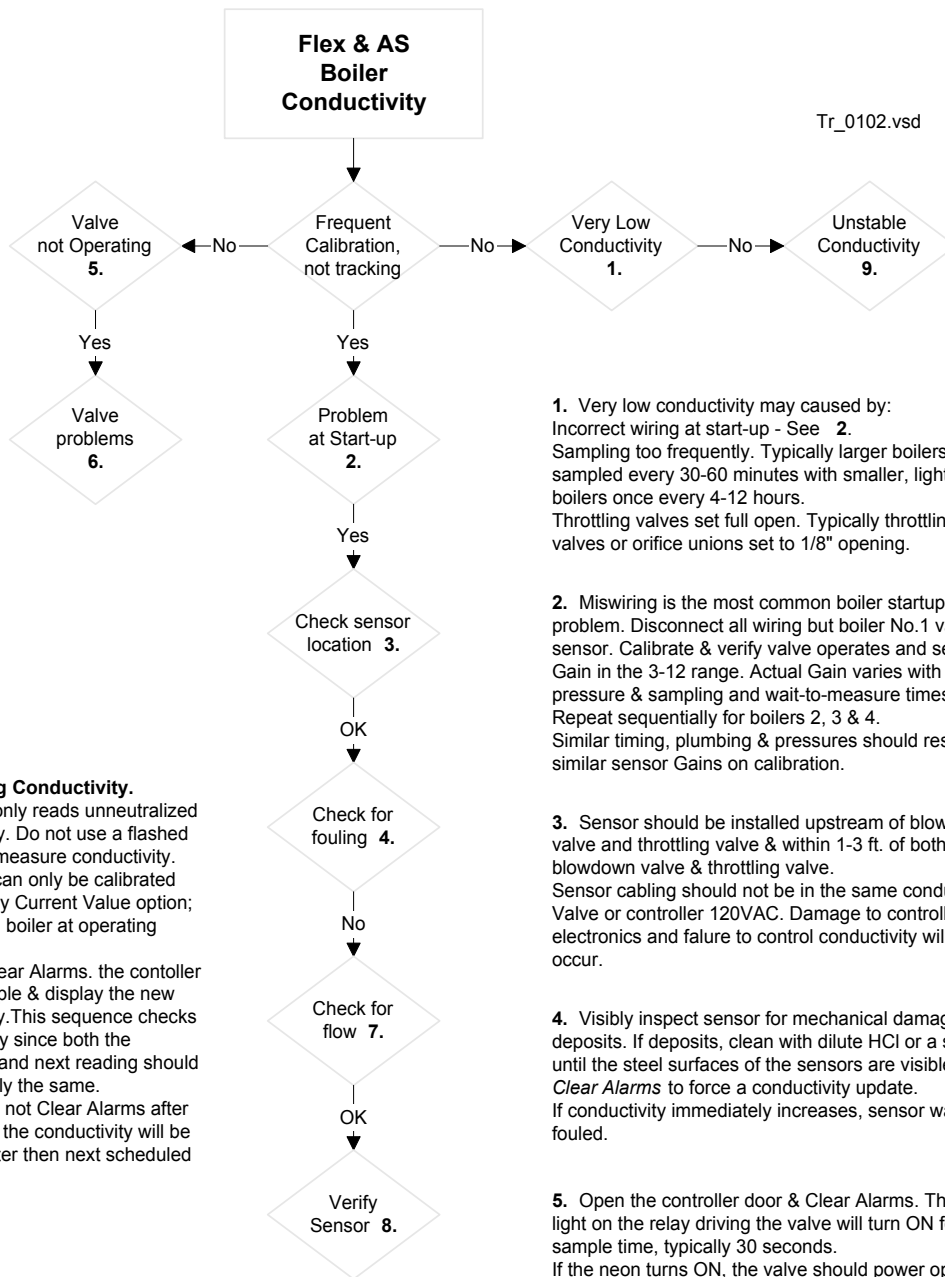
Sample coolers may not be plumbed from the surface blowdown lines so the operator sample may not reflect what the controller is measuring.
Flashed samples typically do not measure the same conductivity and non-flashed samples.

SYMPTOM

Frequent controller recalibration.

FIX

Ensure that tested conductivity sample reflects what the controller sensor is measuring.



Calibrating Conductivity.

1. Sensor only reads unneutralized conductivity. Do not use a flashed sample to measure conductivity.
2. Sensor can only be calibrated with the Key Current Value option; in-line, with boiler at operating pressure.
3. If you Clear Alarms, the controller will re-sample & display the new conductivity. This sequence checks repeatability since both the calibration and next reading should be nominally the same.
4. If you do not Clear Alarms after calibrating, the conductivity will be updated after then next scheduled sample.

8. Remove the sensor, twist the two sensor wires together and measure 1 ohm or less between the sensor pins. Sand the pins to ensure you have a good connection to the pins. An open circuit is a failed sensor. Calibrating a failed sensor will result in a Gain >20. Wiring errors can also cause the same Gain.

9. A valve or solenoid that does not close or is partially blocked will cause the conductivity to wander, with varying Gains. Test the sensor - See 8.

1. Very low conductivity may be caused by:
 Incorrect wiring at start-up - See 2.
 Sampling too frequently. Typically larger boilers are sampled every 30-60 minutes with smaller, light load boilers once every 4-12 hours.
 Throttling valves set full open. Typically throttling valves or orifice unions set to 1/8" opening.

2. Miswiring is the most common boiler startup problem. Disconnect all wiring but boiler No.1 valve & sensor. Calibrate & verify valve operates and sensor Gain in the 3-12 range. Actual Gain varies with pressure & sampling and wait-to-measure times. Repeat sequentially for boilers 2, 3 & 4. Similar timing, plumbing & pressures should result in similar sensor Gains on calibration.

3. Sensor should be installed upstream of blowdown valve and throttling valve & within 1-3 ft. of both blowdown valve & throttling valve. Sensor cabling should not be in the same conduit as Valve or controller 120VAC. Damage to controller electronics and failure to control conductivity will occur.

4. Visibly inspect sensor for mechanical damage or deposits. If deposits, clean with dilute HCl or a solvent until the steel surfaces of the sensors are visible. Clear Alarms to force a conductivity update. If conductivity immediately increases, sensor was fouled.

5. Open the controller door & Clear Alarms. The neon light on the relay driving the valve will turn ON for the sample time, typically 30 seconds. If the neon turns ON, the valve should power open. If neon ON but valve closed verify that valve has Power Open to **NO** terminal, Power Closed to **NC** terminal and neutral to **N** terminal. If neon OFF check interlock & verify interlock ON. If Flex, check fuse if no other neon's ON.

6. A partially open valve is either miswired or blocked - visibly inspect valve seating. A Worcester Series36 valve (yellow top) that continues to rotate, has a loose microswitch. Power OFF, remove the cover & tighten switch mounting. If not a Worcester valve, contact the valve vendor for correct 3 wire valve wiring terminals.

7. Clear Alarms & verify that the piping downstream of the blowdown valve is too hot to touch. If not very hot, surface blowdown line is blocked or valved OFF.