



## Series 93/193 and Series 94/194 Low Water Cut-Off/Pump Controllers

### For Steam Boilers and Level Control Applications Troubleshooting Supplement

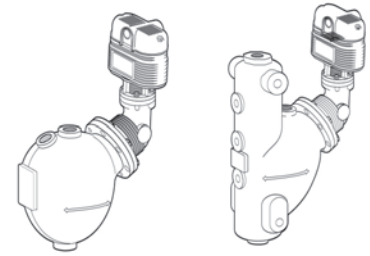
Troubleshooting problems in steam systems and level control applications can be difficult and frustrating. Remember that the control is only reacting to the water level in the boiler and may be doing its job while some other system component may not be operating properly. **Be sure to troubleshoot the whole system, not just the control.**

#### Is the pump sized properly and operating at full capacity?

- The pump should be sized to pump at least 2 times the steaming capacity of the boiler.
- Pump capacity is reduced if the pump impeller is worn or seals/packing leak.

#### Is the modulating valve operating properly?

- Are linkages properly connected?
- Does the motor accept a 0 to 135 ohm signal?



Series 93 or 94      Series 193 or 194

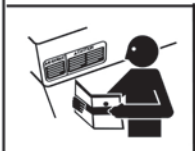
#### Have the system dynamics changed from original installation?

- The water level will drop faster if additional load has been added or if the boiler is operating at or above its rated capacity.
- The boiler water level will fluctuate widely if valves that slowly opened before have been replaced with quick opening valves.

#### Is the system piping clean and in good condition?

- Clogged strainers can reduce the flow of water into the boiler causing the boiler to turn off on low water.
- Partially closed valves can reduce the flow of water into the boiler causing the boiler to turn off on low water.

## **WARNING**



- Before using this product read and understand instructions.



- Save these instructions for future reference.



- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.



- To prevent serious burns, the boiler must be cooled to 80°F (27°C) and the pressure must be 0 psi (0 bar) before servicing.
- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.



- We recommend that secondary (redundant) Low Water Cut-Off controls be installed on all steam boilers with heat input greater than 400,000 BTU/hour or operating above 15 psi of steam pressure. At least two controls should be connected in series with the burner control circuit to provide safety redundancy protection should the boiler experience a low-water condition. Moreover, at each annual outage, the low water cutoffs should be dismantled, inspected, cleaned, and checked for proper calibration and performance.

- To prevent serious personal injury from steam blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.

- To prevent a fire, do not exceed the switch contact rating.

- California Proposition 65 warning! This product contains chemicals known to the state of California to cause cancer and birth defects or other reproductive harm.

- Previous controls should never be installed on a new system. Always install new controls on a new boiler or system.

Failure to follow this warning could cause property damage, personal injury or death.




#### CAUTION:

- A more frequent replacement interval may be necessary based on the condition of the unit at time of inspection. McDonnell & Miller's warranty is one (1) year from date of installation or two (2) years from the date of manufacture.

## Verification of 7B Switch Operation

The 7B Switch is set at the factory to provide a 0 to 135 ohm signal. Sometimes it becomes necessary to verify that the signal is correct at the proper boiler water levels. The following procedure provides information on how to verify the signal sent to the modulating valve or controller.

**The unit is set at the factory and is not intended to be adjusted or calibrated in the field.**

 <b>WARNING</b>	
	<ul style="list-style-type: none"> <li>To prevent electrical shock, turn off the electrical power before making electrical connections.</li> <li>This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.</li> </ul>
	<p>Failure to follow this warning could cause electrical shock, an explosion and/or a fire, which could result in property damage, personal injury or death.</p>

### The boiler should be off-line.

- Attempting to verify setpoints while the boiler is operating/steaming can be difficult.

### Remove cover panel to expose slide wire/resistor mechanism.

- Note the condition of components. If components are discolored or show signs of corrosion, the 7B switch may need to be replaced.
- If sealant has been removed from bracket screws, adjustments may have been made in the field.

#### Note:

Continue with the verification procedure to determine operation. Reasons for making adjustments should be investigated.

### Mark sight glass where valve should be fully open and fully closed.

- See chart or refer to installation instructions MM-404 or MM-413.

### Boiler water level should be at or below lower mark.

- Drain water from boiler by hand using bottom blow down if necessary.

### Note position of slide wire/resistor mechanism.

- Pointer should be at upper end of resistor or on metal band.

#### Note:

If pointer is on white insulator, the 7B switch may have been adjusted in the field. Continue with the verification procedure to determine operation.

### Remove wires from terminal panel with blue dots that connect to the modulating motor.

- Make sure power for modulating motor has been turned off.
- Tag wires so they can be reconnected to terminals.

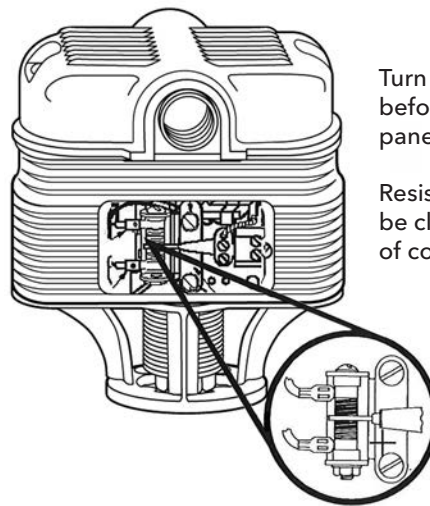
### Connect leads of voltmeter to terminals 1 & 3.

- Reading should be greater than 125 ohms.

### Slowly raise boiler water level.

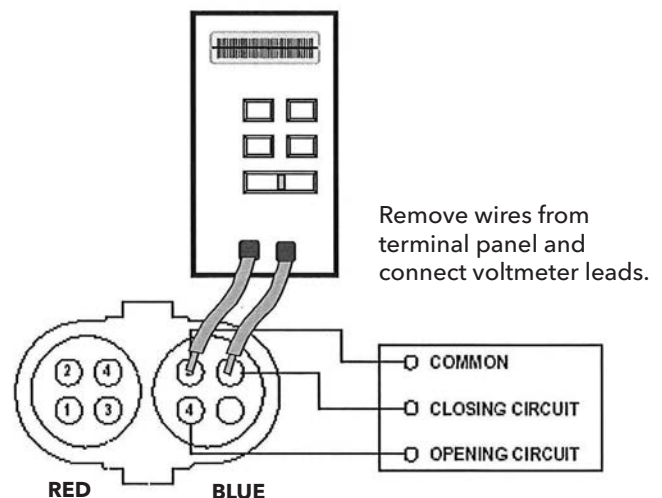
- Use bypass valve to add water which will simulate actual operation.

Setting	All proximate Distance Above Cast Line In. (mm)	Differential In. (mm)
Valve Full Closed	2 <sup>3</sup> / <sub>16</sub> (56)	1 <sup>1</sup> / <sub>16</sub> (27)
Valve Full Open	1 <sup>1</sup> / <sub>8</sub> (29)	
Burner On	1 <sup>3</sup> / <sub>8</sub> (35)	1 <sup>3</sup> / <sub>8</sub> (35)
Burner Off	0	



Turn off electrical power before removing cover panel.

Resistor and finger should be clean with no evidence of corrosion or burning.



## Verification of 7B Switch Operation (cont.)

### Note operation of slide wire and voltmeter reading as the water rises.

- Finger should begin moving down as the water rises above lower mark on sight glass.
- Meter reading should decrease as pointer begins to move down resistor.

### Close bypass valve when water is at upper mark on sight glass.

- Pointer should be at lower end of resistor or on lower metal band.
- Voltmeter reading should be less than 5 ohms.

**Note:**

**If pointer is on white insulator, the 7B switch may have been adjusted in the field. Continue with verification procedure to determine operation.**

### Slowly lower boiler water level.

- Use bottom blow down valve to drain water which will simulate actual operation.

### Note operation of slide wire and voltmeter reading as the water lowers.

- Finger should begin moving up as the water falls below upper mark on sight glass.
- Meter reading should increase as pointer begins to move up resistor.

### Close blow down valve when water is at lower mark on sight glass.

- Pointer should be at upper end of resistor or on metal band.
- Reading should be greater than 125 ohms.

**Note:**

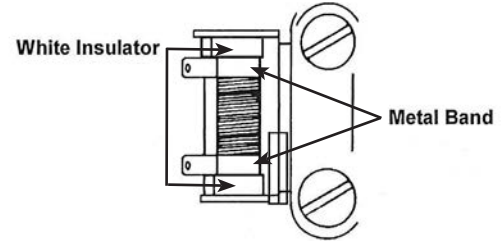
**If pointer is on white insulator, the 7B switch may have been adjusted in the field. Continue with verification procedure to determine operation.**

### Repeat procedure several times.

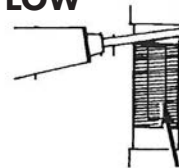
- Pointer should move freely up/down resistor with little or no hesitation.
- Meter readings at upper and lower ends of travel should be the same for each cycle with little or no variance. The most important reading is the when the finger is at the bottom of the resistor (water level up) which should always be 5 ohms or less to ensure that the modulating motor is fully closed.

### Reconnect modulating motor wires to terminal panel.

- Repeat the verification procedure noting operation of modulating motor and linkages. The valve stem stroke or linkages may need to be adjusted to ensure valve is completely closed when water level is at the upper mark.

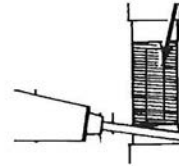


### LOW



With boiler water level at lower mark on gauge glass, the pointer should be in this position. The reading on the voltmeter should be greater than 125 ohms.

### NORMAL



With boiler water level at upper mark on gauge glass, the pointer should be in this position. The reading on the voltmeter should be less than 5 ohms.

## TROUBLESHOOTING

Erratic operation of the control is the most common symptom that occurs. Erratic operation can be defined as pump and/or burner switches not switching at proper levels. Refer to the following list of items to check if the control is not operating properly.

- **Float Ball is Crushed**

Crushed floats are typically caused by improper blow down or as a result of system water hammer. Drain piping from blow down valve to drain should be checked for proper pitch and the blow down procedure followed when blowing down control. Purchase and install a new float ball after investigating and correcting problem.

- **Float Ball is Filled with Water**

The seam weld on the float can sometimes deteriorate. This can be caused by normal wear and tear or may be due to the type of chemical treatment used in the boiler. While this is a rare occurrence, the chemical treatment supplier should be consulted to determine if a reaction could occur. Purchase and install a new float ball after investigating and correcting problem.

- **Float Arm Springs are Bent**

The pivot springs located on either side of the float rod should be flat and straight. If they become bent, the usual cause is mishandling of the unit during installation or improper blow down. The control should never be picked up by the float ball or allowed to hang from the bowl by the float. Drain piping from blow down valve to drain should be checked for proper pitch and the blow down procedure followed when blowing down control. Purchase and install new control or head mechanism after investigating and correcting problem.

- **Resistor is Dirty or Corroded**

The resistor can become corroded from exposure to moisture in the atmosphere. Dust and dirt may also come to rest on the resistor surfaces. By lightly rubbing a pencil eraser against the resistor, the dirt and corrosion can be removed, restoring the unit to normal operation.

- **Switch Contact Springs are Broken**

The contact springs can break if the electrical rating is exceeded on a regular basis. Purchase and install new switch assembly or head mechanism after investigating and correcting problem.

- **Switch Contact Springs are Misaligned**

Misalignment of the contact arms is rare and usually is associated with damage to the control during shipment or installation. Purchase and install new switch assembly or head mechanism after investigating and correcting problem.

- **Internal (Wetted) Parts are Dirty**

The internal parts could become stuck or operate sluggishly if dirt, scale, or rust are allowed to accumulate. This condition could be caused by not blowing down as recommended and/or improper boiler water chemical treatment. Purchase and install new control or head mechanism after investigating and correcting problem.



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