



ITT

McDonnell & Miller

Installation & Maintenance
Instructions
MM-414(B)

Series 150E and 157E



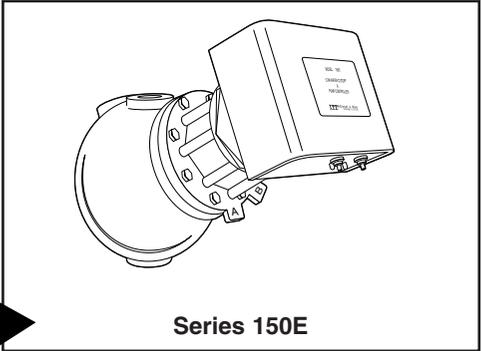
U.S. Pat. No. 6,571,625

Low Water Cut-Off/Pump Controllers For Steam Boilers and Other Level Control Applications

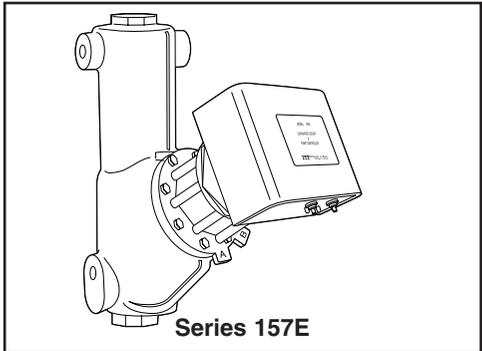
Typical Applications:

- Primary or secondary pump controller/ low water fuel cut-off for steam boilers
- Motorized valve controller
- Low water and high water cut-off
- Dual pump control
- Alarm actuator

with
**MERCURY
FREE**
1 HP
Relays

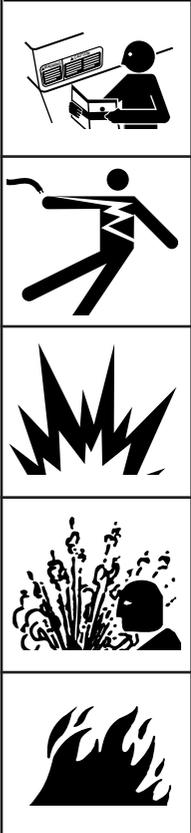


Series 150E



Series 157E

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 cut-offs 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 use this low water cut-off to switch currents over 16A, 1 Hp at 120 VAC or 8A, 1 Hp at 240 VAC, unless a starter or relay is used in conjunction with it.
- Failure to follow this warning could cause property damage, personal injury or death.

SPECIFICATIONS

Maximum Pressure: 150 psi (10.5 kg/cm²)

ELECTRICAL RATINGS & SWITCH RATINGS					
Supply Voltage	Probe Voltage	Full Load (Amps) NO (NC), VAC	Locked Rotor (Amps) NO (NC), VAC	Pilot Duty (VA) NO (NC), VAC	Motor (HP) NO (NC), VAC
120 VAC 50/60 HZ	5 VAC maximum	16 (5.8), 120	96 (34.8), 120	470 (290), 120	1 (1/4), 120
		8 (2.9), 240	48 (17.4), 240	470 (290), 240	1 (1/4), 240

Burner Delay (DOB): 0 to 60 seconds (Field Adjustable)

Ambient Temp: 120°F Max.

NOTE: The circuit board is protected with a sensor which will shut down the unit if the temperature at the board exceeds 176°F (80°C). The board will reset when the temperature at the board drops below 167°F (75°C).

FEATURES

Burner Relay Time Delay

There is a field-adjustable time delay (DOB) to prevent nuisance burner shut-down. The number of seconds water needs to be off the bottom probe before the burner relay is deactivated can be set between 0 and 60 seconds.

Redundant Low Water Cut-Off

When the boiler water drops below the middle probe, a 3 minute timing circuit will be activated. If water does not return to the middle probe within three minutes, the burner relay will deactivate. The Red LED will flash once every second if this condition occurs.

- Automatic Reset units will automatically reset when the water level is restored to the middle probe.
- The reset button on Manual Reset units will have to be pressed after water is restored to the middle probe.

NOTE: The timing circuit will automatically reset if the water level is restored to the middle probe within 3 minutes.

Redundant Pump Off

The pump relay will be activated after water drops below the middle probe. If the water level is not restored to the top probe within 3 minutes the pump relay will be deactivated. After the pump relay is deactivated, normal operation is resumed. Water must again drop off the middle probe to activate the pump relay. There is no LED signal for this occurrence.

CSD-1 Code Compliance

On Manual Reset units, if the control is in a low water condition (burner relay deactivated) prior to an interruption of power, the control will remain in a low water condition when power is restored. The reset button will need to be pressed when the water level again covers the middle probe.

Adjustable Pump Differentials

SWITCH SETTINGS:

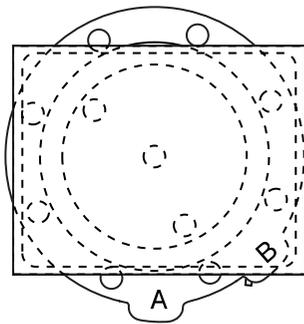
Values are $\pm 3/16$ " (6mm).

When the water level in the boiler drops below the middle probe, the circuit is broken which will activate the pump relay. When the water level rises above the top probe, the circuit is made and the pump relay is deactivated.

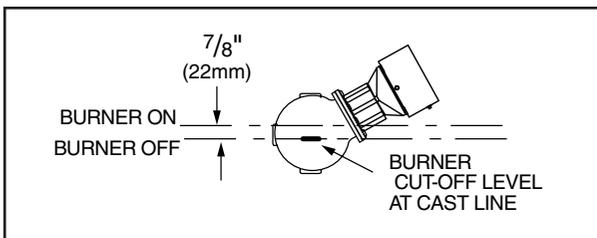
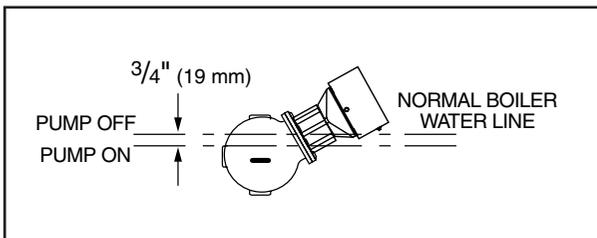
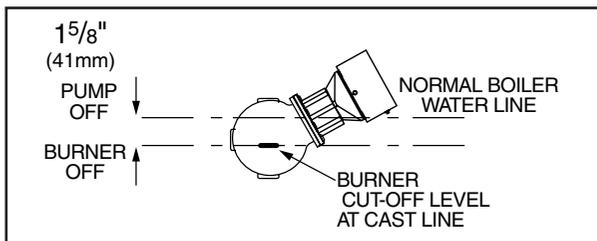
The distance between the top and middle probes is adjustable. By turning the flange one bolt hole clockwise, the distance can be increased by $7/16$ ".

When the water level in the boiler drops below the bottom probe, the circuit is broken which will deactivate the burner relay. When the water level is restored to the middle probe, the burner relay will be activated for auto reset controls only.

Flange in "A" Position

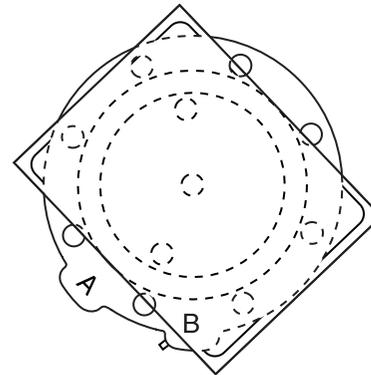


Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
Pump Off	1 ⁵ / ₈ (41)	3/4 (19)
Pump On	7/8 (22)	
Burner On	7/8 (22)	7/8 (22)
Burner Off	0 (0)	

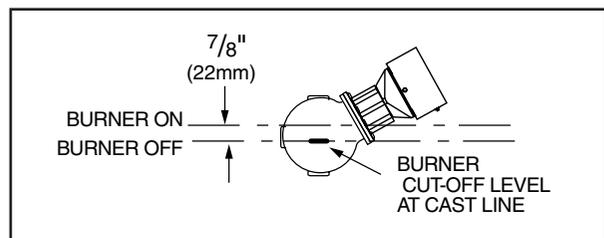
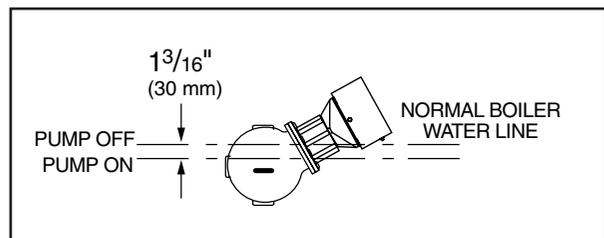
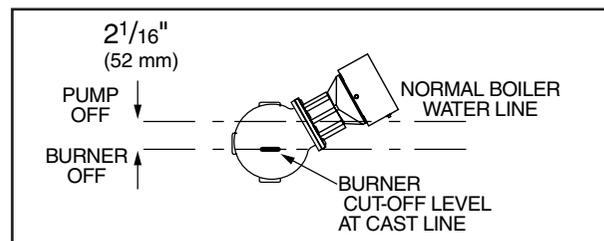


Burner Off has adjustable 0-60 second time delay.

Flange in "B" Position



Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
Pump Off	2 ¹ / ₁₆ (52)	13/16 (30)
Pump On	7/8 (22)	
Burner On	7/8 (22)	7/8 (22)
Burner Off	0 (0)	



Burner Off has adjustable 0-60 second time delay.

INSTALLATION –

TOOLS NEEDED:

Two (2) pipe wrenches, one (1) flatblade screwdriver, and pipe sealing compound.

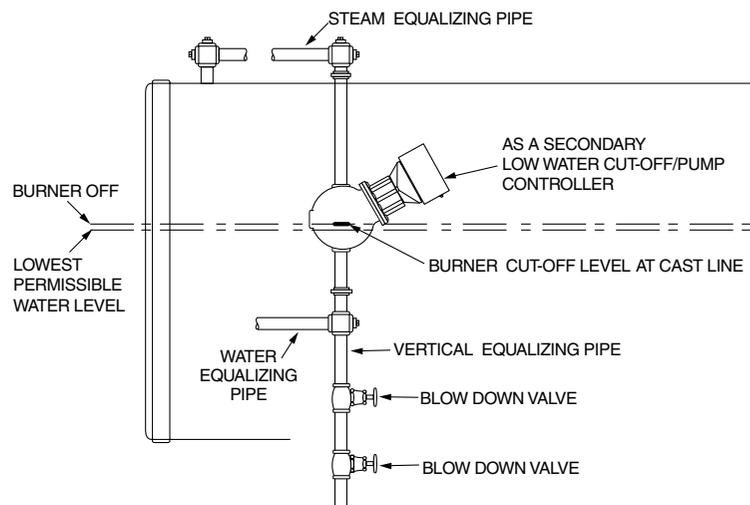
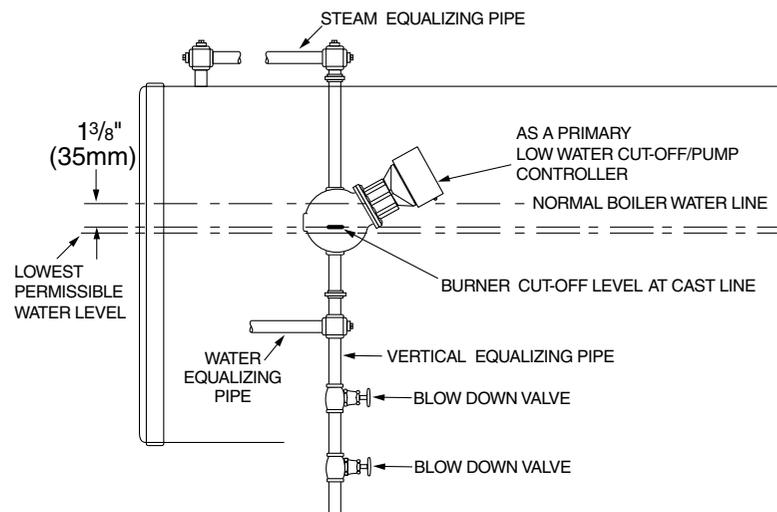
IMPORTANT: Follow the boiler manufacturer's instructions along with all applicable codes and ordinances for piping, blow down valve and water gauge glass requirements.

STEP 1 - Determine the Elevation at Which the Low Water Cut-Off/Pump Controller Must be Installed

If the control will be the **primary low water fuel cut-off**, size the steam (top) and water (bottom) equalizing pipe lengths so that the horizontal cast line on the body is **1 $\frac{3}{8}$ " (35mm) below the boiler's normal water level, but not lower than the lowest safe permissible water level, as determined by the boiler manufacturer.**

OR

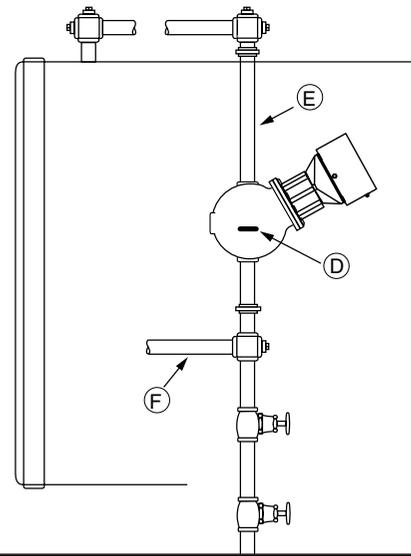
If the control will be the **secondary low water fuel cut-off**, size the steam (top) and water (bottom) equalizing pipe lengths so that the horizontal cast line on the body is **at or above, the lowest safe permissible water level, as determined by the boiler manufacturer.**



STEP 2 - Installing the Low Water Cut-Off

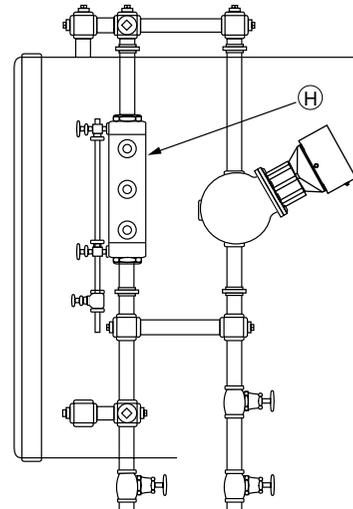
- a. Mount and pipe the low water cut-off (D) on a vertical equalizing pipe (E) at the required elevation level, as determined in Step 1.

Install blow down valves directly below the lower cross of the water equalizing pipe (F).

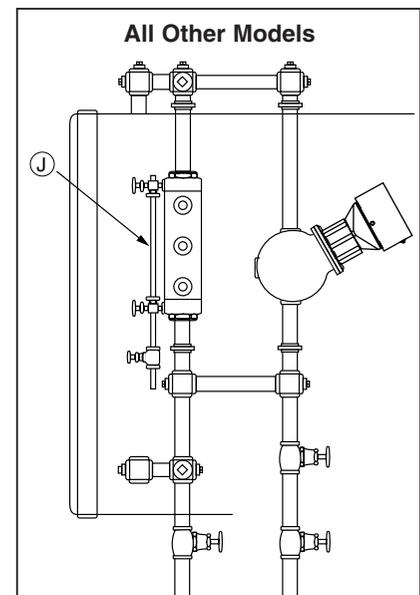
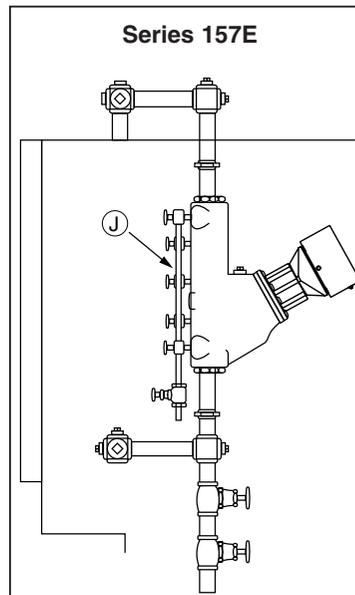
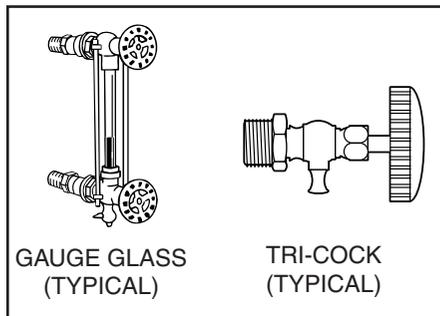


STEP 3 - Installing a Water Gauge Glass (Required on all steam boilers)

- a. Install a water column (H) (not included with product) for all models except Series 157E, (with integral water column).

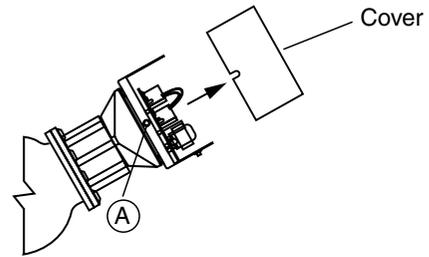


- b. Install a water gauge glass (J).
Note: Gauge glass and tri-cocks not included with product.

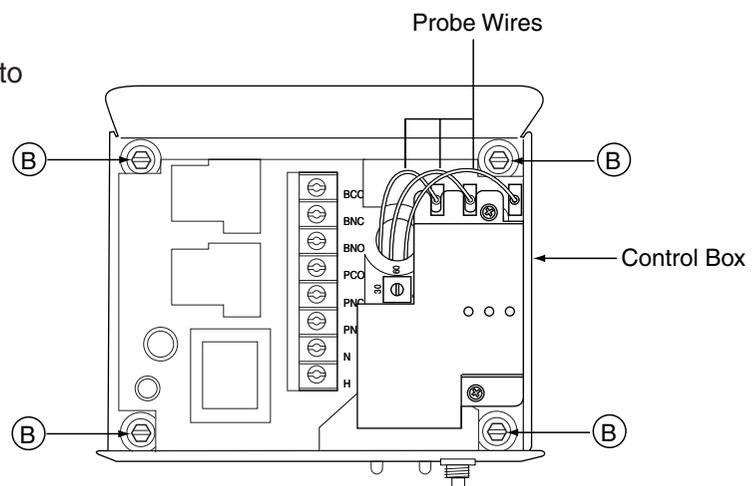


Remote Mounting of the Control Box

Loosen screws (A) and remove cover.

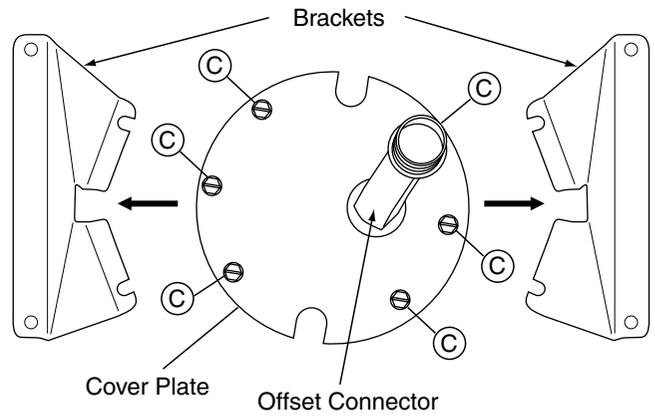


- Disconnect probe wires (red, blue, yellow) from circuit board.
- Remove 4 screws (B) connecting control box to brackets, lifting control box from brackets.



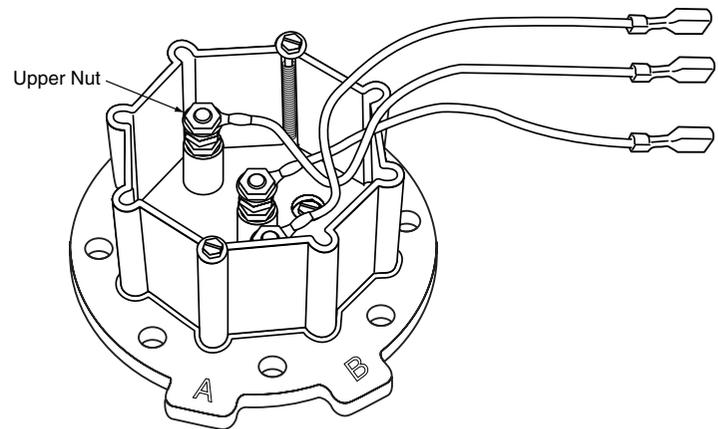
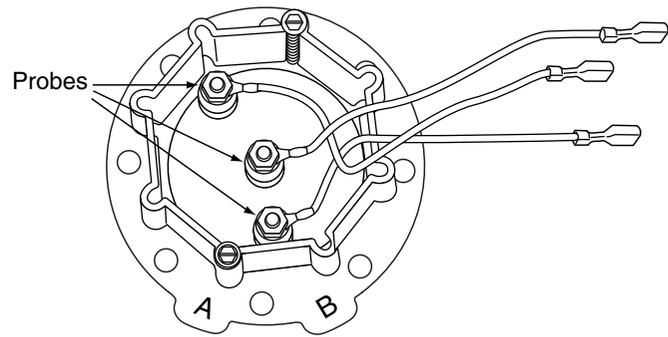
- Remove 6 screws (C) connecting brackets and cover plate to probe housing.

- Remove offset connector from cover plate.



Disconnect wires from probes.

NOTE
Only loosen upper nut to remove probe wire.



- Mount **Control Box** in a suitable location near the boiler's main electrical panel.

NOTE

Boiler sight glass must be visible from location of Control Box and must be within 25 feet of Control Box.

- Install electrical conduit between **Probe Housing** and **Control Box**.

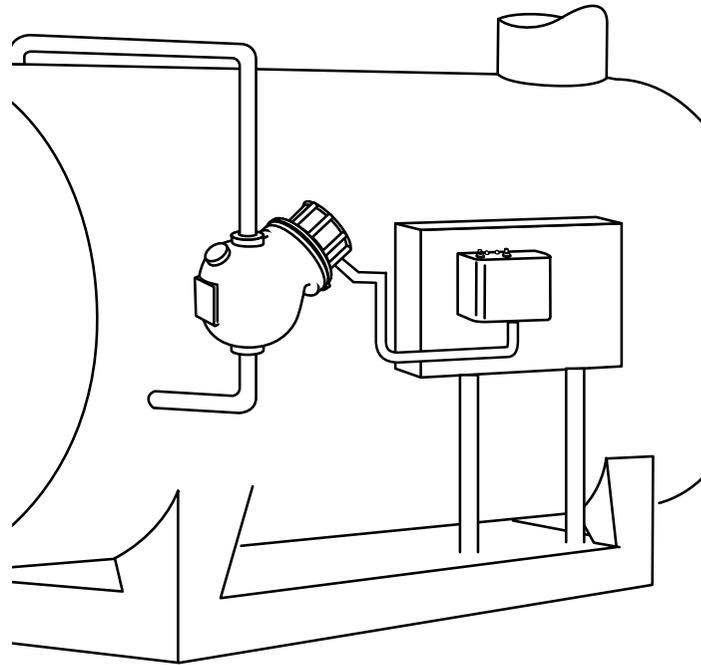
NOTE

Wire must be 18 AWG stranded with glass braided silicone jacket (UL 3071) suitable for high temperature (200°C) service.

NOTE

Refer to and follow local codes and standards when selecting conduit and electrical fittings. Wires from Probe Housing to Control Box must be in their own conduit. If they are run in conduit with other wires, there may be interference that can affect the performance of the control.

- Pull four (4) wires through conduit.

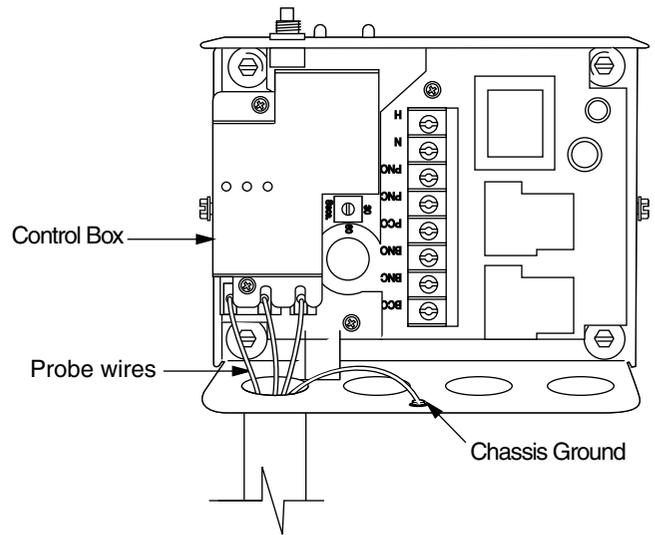
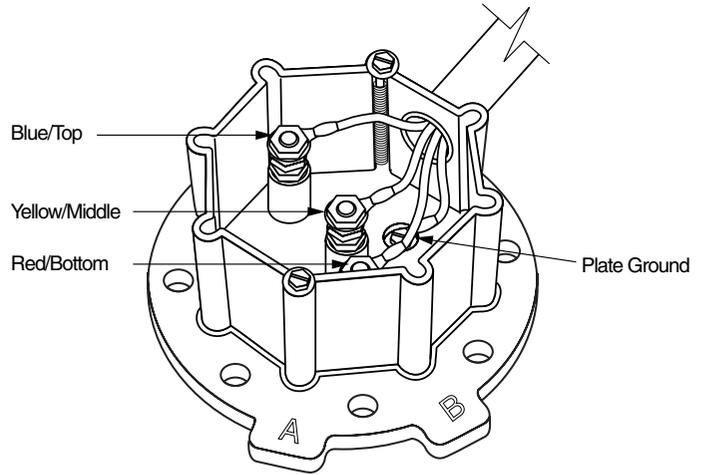


Connect wires between **Control Box** and **Probes** as follows.

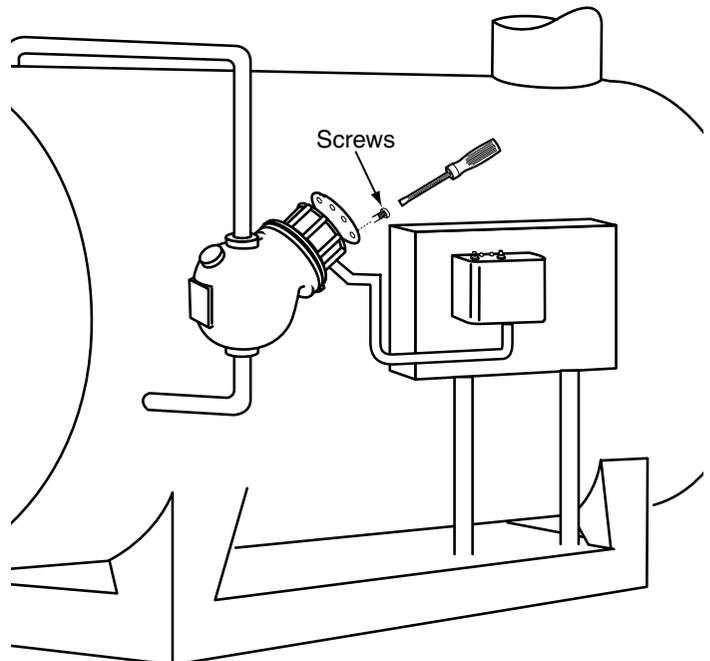
Probes	Control
Top/Blue	Top/Blue
Middle/Yellow	Middle/Yellow
Bottom/Red	Bottom/Red
Plate Ground	Chassis Ground

NOTE

Wire connections at Probes (1/4" Ring Terminal) and Control Panel (22-18 Female Spade) must be made with connectors suitable for high temperature (200°C) service.



- Attach cover plate to probe housing.
- Use knockout plug from probe housing to plug the hole in the cover plate.
- Proceed to Electrical Wiring Section to complete wiring to Burner and Pump/Valve circuits.



STEP 4 - Electrical Wiring

WARNING



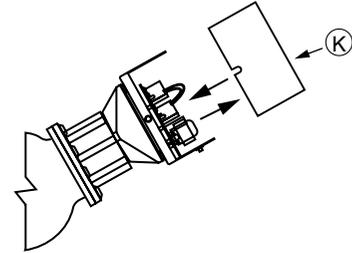
- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.
- Boiler manufacturer schematics should always be followed. In the event that the boiler manufacturer's schematic does not exist, or is not available from the boiler manufacturer, refer to the schematics provided in this document.



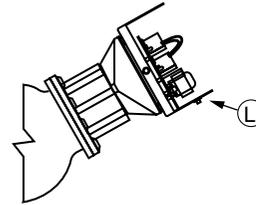
Failure to follow this warning could cause electrical shock, an explosion and/or a fire, which could result in property damage, personal injury or death.

Cover Removal and Installation Procedure

- To remove cover, use a flatblade screwdriver to loosen screws and remove the cover (K).
- To reconnect cover, slide over brackets and tighten screws using a flatblade screwdriver.

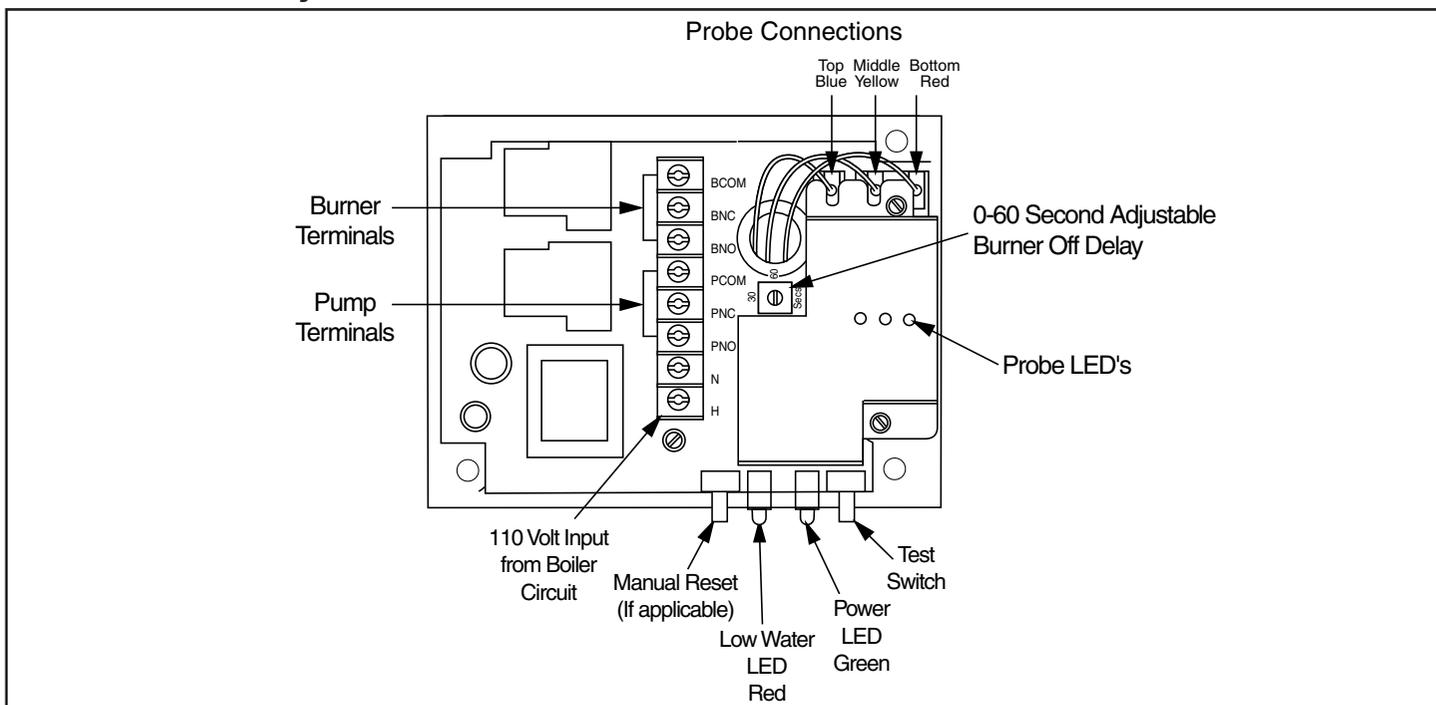


- Following the appropriate wiring diagram (refer to page 11) based on your application requirements, and using BX armored cable or Thinwall electrical metal tubing connector fittings, make electrical connections to the junction box (L).



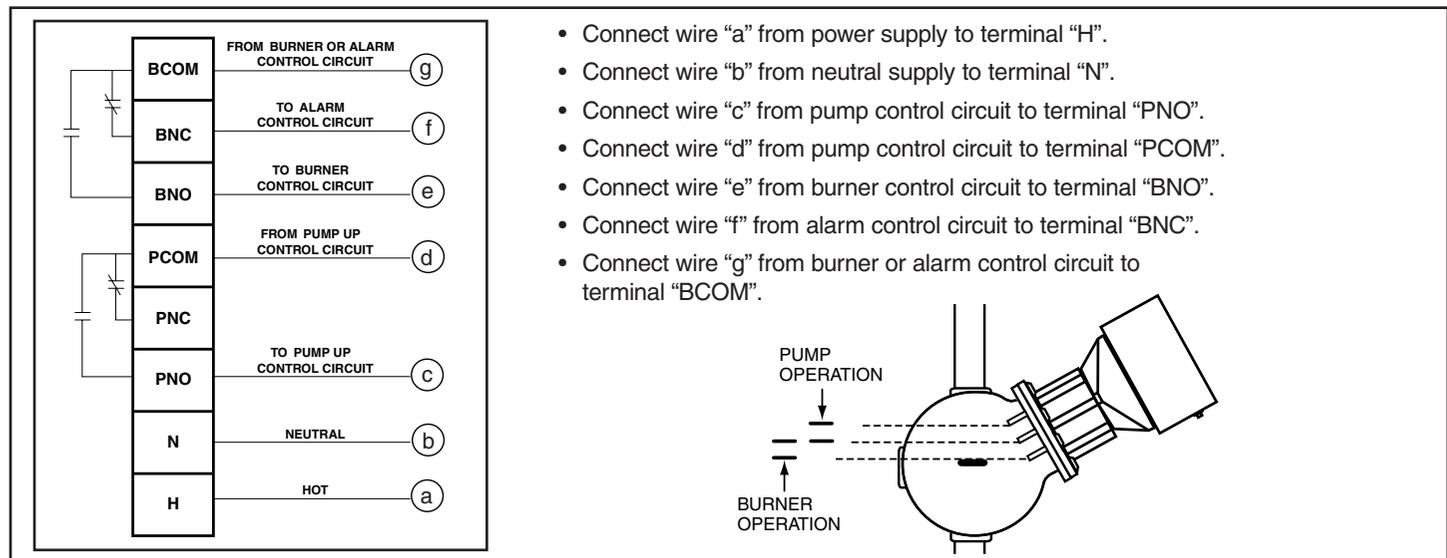
IMPORTANT: There must be a minimum space of 1/2" (13mm) between connector fittings and electrical live metal parts.

Circuit Board Layout

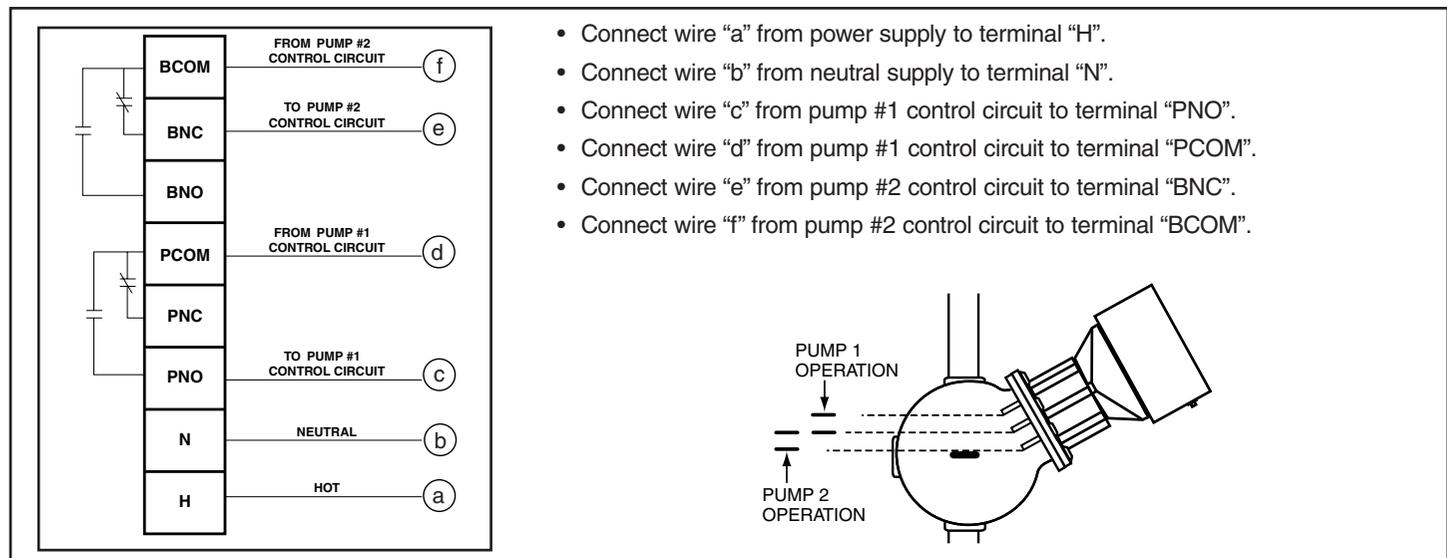


WIRING DIAGRAMS

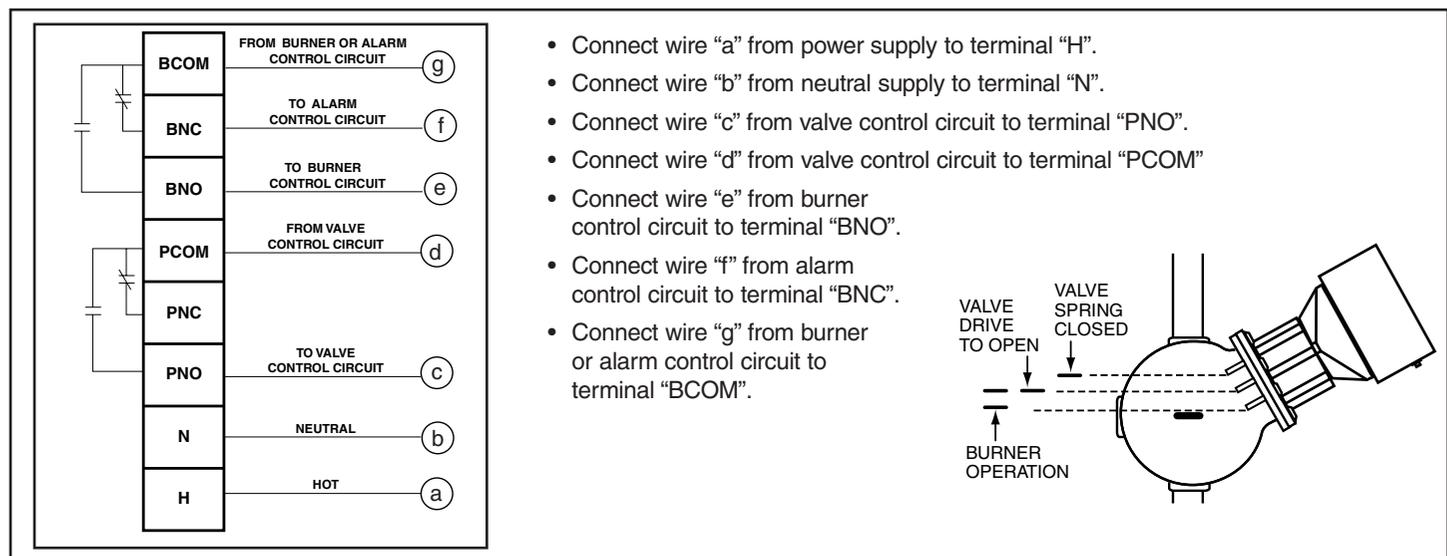
Low Water Cut-Off, Alarm and Pump Up Control



Dual Pump Control



Motorized Valve and Low Water Cut-Off



STEP 5 - Testing

IMPORTANT: Follow the boiler manufacturer's start-up and operating instructions along with all applicable codes and ordinances.

Exterior Lights

- **Green light on:** Unit has power
- **Red light on:** Boiler water dropped below the bottom probe for longer than the adjustable time delay setting. The burner has shut down.
- **Red light flashing every second:** Boiler water was below the middle probe for more than three minutes and the burner has shut down.
 - **Auto reset units** will automatically reset when the boiler water returns to the middle probe.
 - **Manual reset units** must be manually reset after boiler water returns to the middle probe.
- **Red light and green light flashing alternately every 1/2 second.** Probes are out of sequence. Unit has shut down. Unit will automatically reset when condition has cleared or been corrected.
- **Red light and green light flashing simultaneously every 1/2 second:** The PCB is too hot and the unit has shut down. The unit will automatically restart when the PCB has cooled sufficiently.
- When using the "TEST" button, the green light will flash once per second during the time delay interval. The time delay setting can be determined by counting the number of flashes.

Interior Lights

Green Light – Shows status of top probe

Yellow Light – Shows status of middle probe

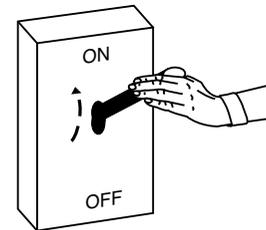
Red Light – Shows status of bottom probe

- If the light is on, the probe is in water and probe resistance is well below the threshold.
- If the light is flashing every 1/2 second, the probe is in water, but probe resistance is near (just below) the threshold.
- If the light is flashing every 2 seconds, the probe is out of water, but probe resistance is near (just above) the threshold.
- If the light is off, the probe is out of water and probe resistance is well above the threshold.

Procedure

Turn on power to the boiler and pump circuits. With the boiler empty, the control will be activated (Green LED On) and the pump should turn on. The burner should stay off (Red LED On).

NOTE: If Green and Red LED's flash alternately, the probes are not connected in sequence. Turn off power and check probe wires for proper connection.



WARNING



If the burner comes on, immediately turn the boiler off and make the necessary corrections.



Failure to follow this warning could cause an explosion or fire and result in property damage, personal injury or death.

The boiler should begin to fill with water.

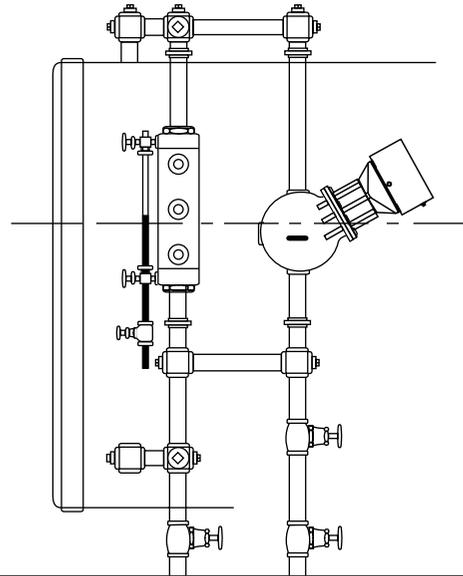
NOTE: If water does not start filling the boiler, immediately turn off the boiler and make the necessary corrections.

For Automatic Reset Models:

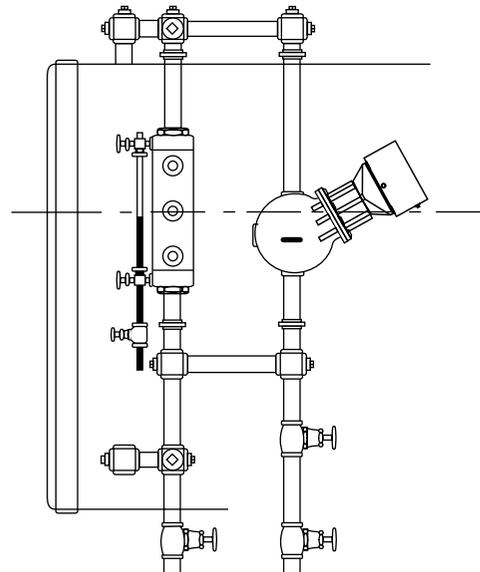
When the water level reaches the level of the middle probe, the burner circuit should be activated and the Red LED should turn off. (Pump #2 should turn off with Dual Pump Applications).

For Manual Reset Models:

The reset button must be pushed to activate the burner circuit when water reaches the level of the middle probe.



When the water level rises to the level of the top probe, the pump relay will be de-activated. Depending on the application, this will either turn off the pump or close a valve.



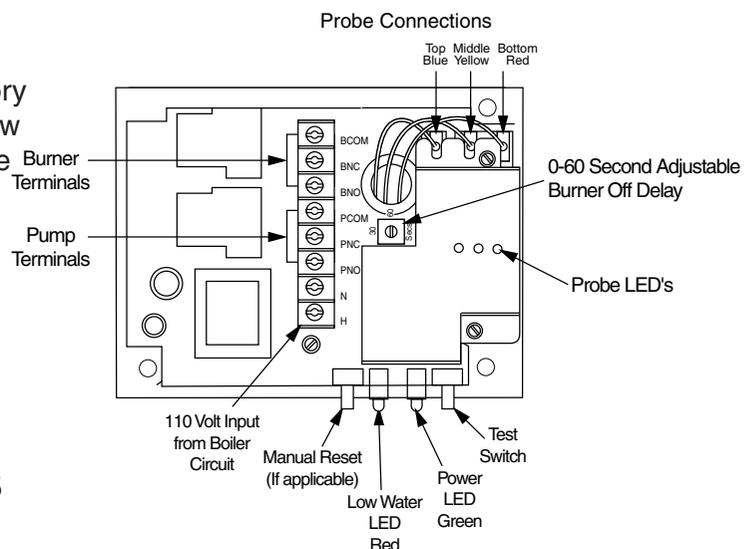
Adjusting Burner Delay (DOB)

The number of seconds that water must be off the bottom probe before the burner will turn off is adjustable from 0 to 60 seconds with the unit factory set at 0 seconds. To adjust, turn the adjusting screw clockwise using a small flatblade screwdriver to the delay time desired.

NOTE

If the delay time is too long, the manual reset secondary LWCO may turn off the boiler before this control turns off the boiler. If this occurs, shorten the time delay by turning the adjustment screw counter-clockwise from the new setting.

Follow the blow down procedure found on page 15 to verify operation.



INSTALLATION COMPLETE

Troubleshooting

Green LED does not turn on.

- There may be no power to the unit. Check wiring connected to 'H' and 'N' terminals on circuit board. Verify that the control is being powered when the boiler power is turned on.

Red & Green LEDs flash alternately every 1/2 second.

- The probes are out of sequence. Check probe wires and connections.
- The control head flange is not installed properly. "A" or "B" tabs must be installed at bottom of body.

Red & Green LEDs flash simultaneously every 1/2 second.

- The temperature at the circuit board is higher than 170°F. Removing the control box cover may cool the control enough for it to operate. If the control works with the cover removed, the control box should then be mounted remotely.

Pump does not turn off when water level is above top probe.

- The probes may be fouled with dirt, scale or rust. Remove head assembly to inspect probes.
- The wiring connections for the pump may not be connected properly. Check wiring at terminals.

Pump does not turn on when water level is below the middle probe.

- The probes may be fouled with dirt, scale or rust. Remove head assembly to inspect probes.
- The wiring connections for the pump may not be connected properly. Check wiring at terminals.

Burner does not turn off when water level is below bottom probe.

- The probes may be fouled with dirt, scale or rust. Remove head assembly to inspect probes.
- The wiring connections for the pump may not be connected properly. Check wiring at terminals.
- Make sure time delay is not causing delay of burner off.

The 150E control does not turn off the burner before the secondary (manual reset LWCO) turns off the burner.

- The burner off time delay (DOB) may be set for too long of a delay.

During operation, the burner does not turn off when the water level is below the bottom probe.

- The burner off time delay (DOB) may be set for too long of a delay.
- The boiler water may be priming or foaming. Clean boiler water and/or consult with chemical treatment specialist.

During operation, the burner turns off even when the pump has turned on or the motorized valve has opened.

- Pump capacity may not be sufficient or there may be restrictions in the feedwater piping. Check pump capacity and piping.
- The motorized valve stroke-to-open time may be too long. Check valve motor timing.

MAINTENANCE

SCHEDULE:

Blow down control as follows when boiler is in operation.

- Daily if operating pressure is above 15 psi.
- Weekly if operating pressure is below 15 psi.

NOTE
More frequent blow-down may be necessary due to dirty boiler water and/or local codes.

Disassemble and inspect annually.

- **Inspect the float/probe chamber and equalizing piping annually.** Remove all sediment and debris from chamber and/or equalizing piping.
- **Inspect and clean probes.** Use a non-abrasive cloth to clean probes and water-side of probe-mounting flange. Replace head mechanism and probes if probes are worn, corroded or have excessive coating of scale or rust that cannot be easily cleaned off.

WARNING
DO NOT REMOVE PROBES FROM FLANGE. Replace probe flange assembly if probe Teflon® insulation is broken, torn or frayed.

NOTE
The probes may need to be inspected and cleaned more frequently on systems where there is the potential of coating build-up on the probes. This includes systems: <ul style="list-style-type: none">• With high raw water make-up• With no condensate return• With untreated boiler water• Where significant changes have been made to the boiler-water chemical treatment process• With oil in the boiler water

Replace head mechanism every 5 years.

More frequent replacement may be required when severe conditions exist.

Replacement parts are available from your local authorized McDonnell & Miller Distributor. The use of parts or components other than those manufactured by McDonnell & Miller will void all warranties and may affect the units' compliance with listings or regulating agencies.

BLOW DOWN PROCEDURE:

 CAUTION	
	To prevent serious personal injury from steam pipe blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge. Failure to follow this caution could cause personal injury.

When blowing down a control at pressure, the blow down valves should be opened slowly. The piping needs to be warmed up and stagnant water in the drain piping needs to be pushed out. Suddenly opening a blow down valve causes steam to condensate, which creates water hammer. Damage to components can occur when water hammer occurs due to improper blow down piping.

For these reasons, McDonnell & Miller recommends a dual valve blow-down system for each control.

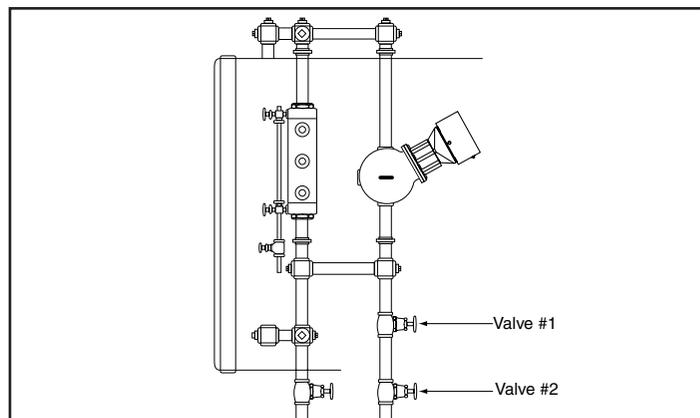
Blow down the low water cut-off when the water level is at its normal level (pump/valve off) and the burner is on.

- Open the upper “Positive Shut-off Ball Valve” (#1).
- Slowly open lower “Throttling Gate Valve” (#2).
- With both valves open, the water level will drop in the sight glass.
- When the water falls below the level of the middle probe, the pump or valve should turn **ON**.
- When the water falls below the level of the bottom probe, the burner should turn **OFF**. **NOTE:** The Red LED will turn **ON** to indicate low water condition.
- Slowly close the lower “Throttling Gate Valve” (#2).
- The water level should begin to rise and the burner should turn **ON** (Red LED turns off) when the level is at the middle probe. The pump or valve should turn **OFF** when the water level rises above the top probe position.

NOTE
If this sequence of actions does not occur, as described, immediately close all valves, turn off the boiler and correct the problem. To correct the problem, inspection/cleaning of all probes may be required.

NOTE: On manual reset models, the red reset button will need to be pressed after the water level is restored to the level of the middle probe before the burner will operate.

- Close the upper valve “Positive Shut-off Ball Valve” (#1).
- Observe that the water level returns to its normal level before leaving the site.





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