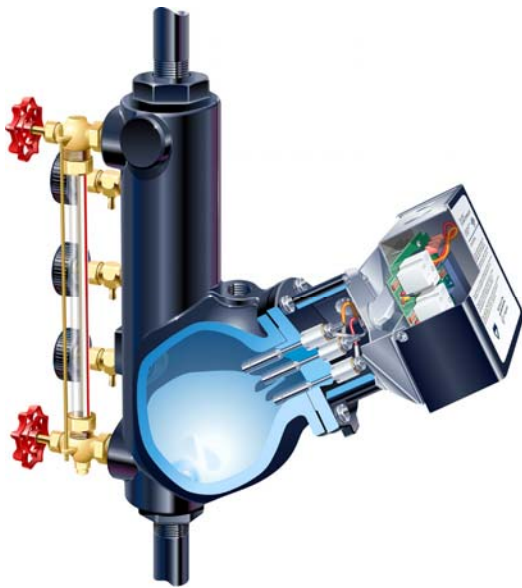




ITT

**Considering the alternatives to the
McDonnell & Miller
Series 150 mercury LWCO?**



Series 150E



Series 150S

Which one is best for me?



150S or 150E?

WHICH IS THE BETTER ALTERNATIVE TO MERCURY?

The McDonnell and Miller Series 150 and 157 Low Water Cut Off / Pump Controller has been in existence for over 50 years. Historically there have been three switching mechanisms for this control: the original float-controlled mercury switch (Series 150); the newer float-controlled snap switch (Series 150S); and the newest electronic conductance-probe design (Series 150E).

The original design utilized a mercury switch and set the standard for the industry. Users appreciated the wide differentials that are inherent in the design of the switching mechanism and the 'rolling action' of the mercury. In addition, the characteristics of the mercury allowed use of higher-horsepower boiler-feed pumps without a separate starter/relay.

Recent environmental concerns have led many states, including Illinois, to pass legislation banning the sale and distribution of products containing mercury. This affects the production and distribution of the original Series 150/157 with mercury switches, as these controls are produced in Illinois. As McDonnell & Miller discontinues making mercury switch controls many users have asked, "*Which alternative is the best replacement for the mercury switch versions: the 150S or the 150E?*" *The answer is both, depending on how you use it and the application.*

Series 150S or 150E Controls are excellent alternatives to controls containing mercury. On the surface, the Series 150S or Series 150E controls appear to provide similar functionality. This can create confusion when choosing the correct product for a particular application.

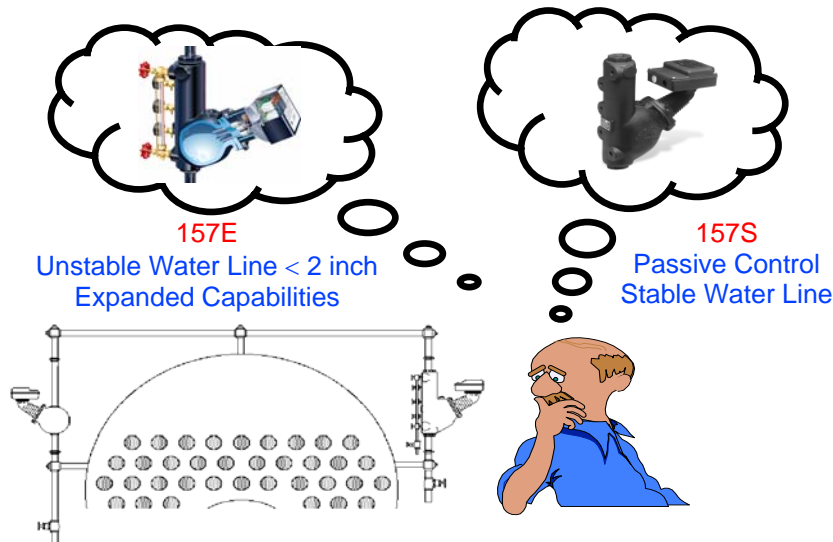
A brief list of each of these controls' characteristics may be helpful as a quick reference.

Series 150S mechanical LWCO/pump controller:

- Passive control (*doesn't require continuous electrical power supply*)
- Float-controlled snap switch controls
- High water content boiler applications characterized by a stable water line
- Boiler / system operating pressure affects Burner and Pump differential set points
- Economy of purchase
- Maximum pump-control differential switches available

Series 150E electronic LWCO/pump controller:

- Non-passive control (*requires continuous electrical power supply*)
- Conductance-probe type controls with switching relays
- Low water content boiler applications characterized by fairly unstable water lines (less than 2-inch fluctuations)
- Differentials not sensitive to boiler operating pressure or system loads
- Field adjustable Pump operating differentials to meet actual boiler operating conditions
- Variable time delay for Burner-off control
- Built-in diagnostic capabilities
- Built-in 15-amp relay Pump and Burner switching capabilities
- CSD-1 compliant



Note that Series 157S or 150E controllers have the same control mechanism as Series 150S or 150E units, but include an integrally cast water column for mounting the gauge glass and tri-cocks.

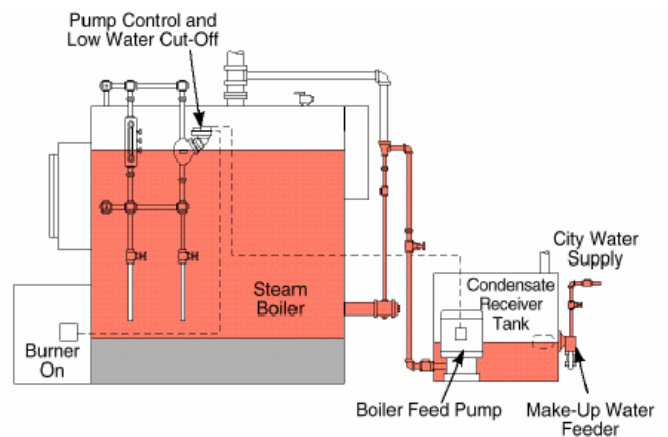
The choice between the Series 150S mechanical or Series 150E electronic LWCO may depend on the specific application. To determine which control best fits the application, first we need to do a quick review of boiler control basics. We can then discuss the application of the Series 150S & Series 150E in detail.

QUICK REVIEW OF BOILER CONTROL OPERATION BASICS

The best way to prevent overheating damage to a boiler is to shut the burner off if the water level in the boiler falls too low. This is the low water cut-off's job. Series 150/150S/150E LWCO controls are designed for steam boilers, but use different technologies to monitor the boiler water level. The 150S uses a mechanical float-operated control, while the 150E uses an electronic probe-type control (also known as conductance probes). Let's look at these different types of boiler controls.

Float Operated Low Water Cut-Offs

Float operated low water cut-offs have been in use since the 1920s, earning a worldwide reputation for reliability. This type of low water cut-off typically mounts in the equalizing piping attached to the side of the boiler (see diagram below). The water level in the low water cut-off's chamber mimics the water level in the boiler. As the water level drops in the boiler during steaming it also drops in the low water cut-off's chamber and the float reacts to the water line. Should the float drop to the boiler's critical low water cutoff point, it will trip an electrical switch that turns the burner off. It will stay off until the water level rises to a safe operating point. This happens when the condensate returns from the system. When the water level reaches a safe position, the low water cut-off will make its electrical connection and the burner can restart. A low water cut-off of this type is called a **"PRIMARY low water cut-off"**.

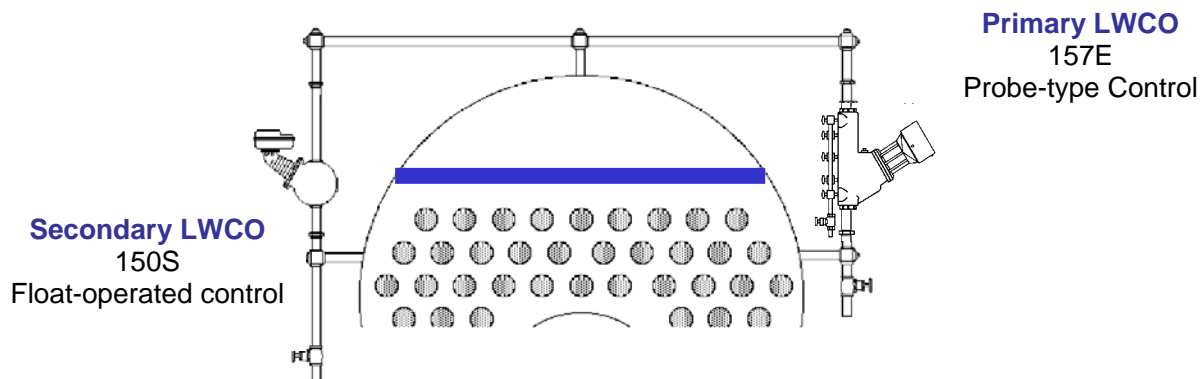


Steam Systems with Boiler Feed Pumps

Typically, water leaves the boiler as steam, condenses into a liquid in the radiators or heat exchangers and piping, and flows by gravity into a condensate receiver. If you have a system where some steam is used for process (meaning it won't be coming back), or if your system isn't well balanced, you should use a condensate receiver, which is usually equipped with a boiler feed pump. The pump's job is to "push" the water back into the boiler.

All Series 150 and Series 150S low water cut-off/pump controllers have two switches for operation at two different boiler water levels. The lower switch controls the burner and the upper switch operates the boiler feed pump. When the boiler needs water, the pump controller recognizes the need and starts the pump. When the boiler water returns to the proper level in the boiler, gauge glass and the float bowl, the pump controller stops the pump. If the pump can't keep up with the boiler's need for water, the low water cutoff/ pump controller will sense this as well. The lower switch cuts the electricity to the burner and protects the boiler while in a low water condition. A control of this type is called a "**PRIMARY low water cut-off/pump controller**".

Per ASME CSD-1 boiler standard, all steam boilers over 400,000 Btu must have two low water cut-offs. The first is an automatic reset (primary control) and the second switch, which is set lower relative to the primary control, is a manual reset control. The second switch is called the "**SECONDARY low water cut-off**". The secondary low water cut-off requires human intervention. Someone must manually depress the reset button to restart the burner after a low water condition. Many times the secondary low water cut-off uses a different technology (either a float type or a probe type low water cut-off) than the primary low water cut-off (see diagram below).

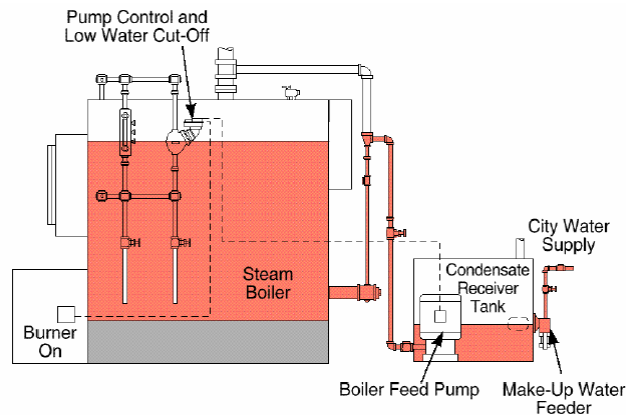


SERIES 150S

Let's start our discussion by looking at the Series 150S controller. The 150S has a few inherent limitations. Pay particular attention to the control's differentials (explained later) and its electrical load carrying capacities.

OPERATION BASICS

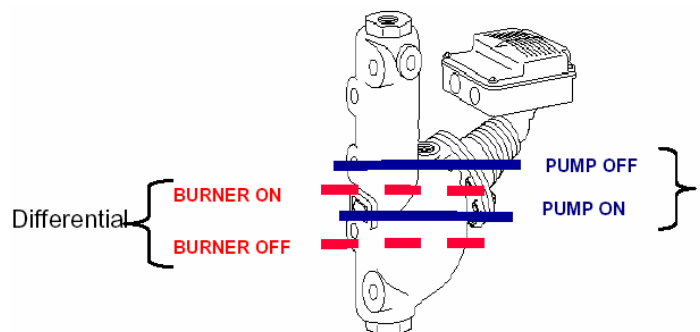
All series150 controls, whether snap switch, mercury switch or electronic models, provide low water cut-off protection and a method for controlling a boiler feed pump. Mounted at the boiler water line, the control starts and stops the pump to maintain a water level in the boiler within limits recommended by the boiler manufacturer in order to maintain maximum steaming efficiency (see diagram below).



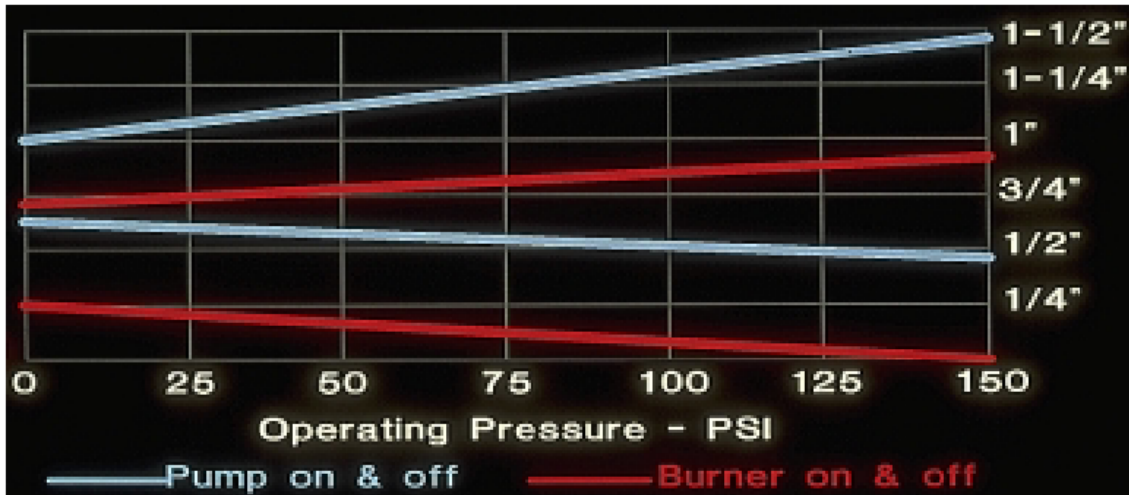
The 150 and 150S units have an upper SPST pump switch and a lower SPDT burner switch, which can provide low water burner cut-off and an alarm function by interrupting the burner circuit when the water drops below the minimum level. It can also provide a low water alarm if desired. The Series 150 and 150S are float-actuated controls that make or break contacts as the water level in the boiler moves up or down. They can be used on boilers of any pressure (150 psi maximum) and any steaming capacity. The Series 150S is both an operating control (pump) and a limit control (burner) combined into one.

DIFFERENTIALS

The term **differential** refers to the distance (in inches) of the boiler water line between events like "Pump On & Pump Off" or "Burner On & Burner Off". Pump and burner switches for Series 150/150S controls have factory set differentials. Some installing contractors learned how to adjust the older mercury switches differential settings, but McDonnell & Miller recommends against this activity for current controllers as the differentials are factory set and **should not be field adjusted**.



It is important to note that differentials in both the original 150 Mercury and 150S Snap Switch units change with pressure. At 150 psi, the differential is twice as large as it is at 15 psi. The Series 150 and 150S units are factory set at 150 psi, which means that when the Series 150/150S is used at a lower pressure, the differentials become smaller. For example, at 150 psi the burner differential is about 7/8 inch, while at zero psi it is less than a 1/2 inch. The chart below shows how the settings change at different pressures (0 to 150 psi).



This is inherent to the float-operated design and caused by the effect pressure has on the bellows assembly within the control. At higher pressures the bellows is stiffer, requiring more force to move it. At lower pressures, the bellows is more pliable (less stiff) requiring less force to move it. Consequently, the on/off points tend to narrow at lower boiler operating pressures meaning there is a smaller differential between turning the "Burner Off" and turning the "Pump On". Surging in the boiler water line could cause a nuisance burner shut down due to the smaller differential between the set points. Premature shut down reduces boiler efficiency and increases energy costs.

'MD' models of the snap switch controls are available to compensate for the narrowing of set points at lower operating pressures. On 'MD' models the distance between Pump Off and Burner Off is increased by approximately 7/16 inches when the boiler operates at 150 psi. This increased differential is accomplished by lowering the burner set point 3/8 inch below the casting line on 'MD' models when we set the Burner On / Burner Off points at 150 psi. This compensates for the narrowing of the set points at lower operating pressures, as the Burner Off point moves upward (closer to the casting line) at lower pressures. The Pump On and Pump Off differential on both the standard and 'MD' models is set at 3/4 inch at 150 psi. **'MD' model controls are recommended for boilers that will operate below 50 psi.**

SERIES 150S (SNAP SWITCH) PRODUCT ENHANCEMENTS

Many of you know that McDonnell & Miller had problems in the field with the Series 150S product family after its introduction in 1996. A lot of effort went into identifying the problems and fixing them on units in the field and new ones coming from the factory. The information below updates you on the progress that has been made.

Switch Contact Overload

Overloaded switch contacts are typically identified by a flooded boiler. McDonnell & Miller discovered that the pump switch is used sometimes to directly start/stop pump motors rated at 1/2 HP or greater. It was also discovered that many pump motors are actually 1/2 HP motors derated to 1/3 HP. In both instances, the switch is subjected to loads exceeding the design capacity of the snap switches. This causes the switch contacts to overheat and weld together, thus not turning off the pump, which keeps the pump running and floods the boiler.

In September 1997, the contact material was upgraded to give the unit a higher current carrying capability. The change improves the life and durability of the switch contacts, but the switch rating remains unchanged. When replacing a mercury switch unit, the rating of the pump must be checked, amperage measurements taken and a starter or relay installed if either the motor rating or the measured amperage exceeds 7.4 amps. ***The snap switch rating is 7.4 amps @ 120 VAC, therefore a starter or relay must be used when these conditions are exceeded.***

Switch Set Point Drift

The symptom of this condition is the same as overloaded snap switch contacts - flooded boilers. While the symptom is the same, the cause is different. Sometimes the switch settings would lose their calibration when exposed to elevated temperatures. When this occurs, the set points drift beyond the upper limit of the float travel and the control fails to turn the pump off. The result is flooding of the boiler or system. However, set point drifting is diminished with use. As a result, once a snap switch unit is installed and operates properly for a period of time, the likelihood of failure due to switch set point drift is minimal.

The switch set point drift problem was fixed by using thermally pre-conditioned snap switches, beginning in May 1998. Pre-conditioning the switch at an elevated temperature stabilizes the switch set points and the units are set at the factory to perform accurately over its lifetime in the field.

Low Pressure Application

A few customers told us that the snap switch units caused rapid cycling of the burner or pump at low pressure. Keep in mind that the unit, whether a snap switch or mercury switch, is reacting to the water line as it rapidly changes. Efforts should be made within the steam system to stabilize the boiler water level. One reason for this rapid cycling is the dynamics of the switch operation. Mercury switch units, by their design, are slightly more forgiving than snap switch units. Because of this, they have more tolerance and are less likely to be affected by the system operating pressure and fluctuating water lines. This is due to the linkages that hold the mercury switches and the rolling affect of the mercury itself within the switch tubes. Snap switch units are more sensitive (quickly changing position) and when the water level rises or falls beyond the set points, the switch quickly changes state. There is no mercury or linkages to compensate for the subtle movements of the float. Because of this, set points and operating differentials appear to be less than they really are.

Improper Balancing Boiler Feed Rate

The symptom of this condition is a flooded boiler, also described as 'switch sticking', 'pump not turning off' or 'pump switch defective'. When the pump is not 'balanced' or 'throttled', a high current load is present when the pump runs. Do not be misled by the nameplate data of the motor. Taking actual amp readings determines the amperage load the switch is actually 'seeing'

during pump operation. It is not unusual to measure actual amp loads in the 8 to 10 amp range for 1/3 HP motors that are actually derated 1/2 HP motors. Since the switch is rated for 7.4 amps, there will be a problem unless the pump is properly balanced. An unbalanced pump delivers water too quickly to the boiler, causing an unstable water line within the boiler and control. This results in rapid float movement and switch operation. Combining a high amperage load with higher start/stop operating frequencies can shorten the switch life as the contacts can eventually overheat and stick. **Boiler feed pumps, like any pump, require proper balancing for most effective operation.**

SERIES 150S SUMMARY

The combination of the improved switch contact materials and use of thermally conditioned snap switches have made the Series 150S controls very reliable. These improvements corrected most, if not all, of the problems users experienced shortly after the Series 150S was introduced.

The Series 150S controls are best used in applications with stable boiler water lines. Users, who take into account the low-pressure set point characteristics of the Series 150S controls and make sure their boiler pumps are properly balanced, have the best results with these reliable and cost effective controls.

The Series 150S controls may not be the best choice for applications where the boiler water line has a lot of movement or if the user does not want to install a starter / contactor for starting the boiler feed pump.

SERIES 150E

The 150E is one of the most thoroughly tested products McDonnell & Miller has ever introduced. These controllers were field-tested for over two years and were brought to the marketplace in 2001, to meet an important need in the changing commercial/industrial boiler market. Like all McDonnell & Miller products, 150E controllers are manufactured to our tough six-sigma requirements. The Series 150E controller provides reliable control of burner circuits, pumps, motor starters and electric valves for low water protection and pump control applications. Typical applications include low water cut-off protection and pump control for steam commercial/industrial boilers. They are available in automatic or manual reset and with an integral water column (157E) for convenient mounting of gauge tapings. Several replacement parts are offered including head assemblies, control units and replacement probe assemblies.

CONDUCTANCE PROBES VERSUS FLOATS

The Series 150E features three conductance type sensing probes to monitor the boiler water line, rather than switches and floats. The lowest probe is for burner-off control; the middle probe shares burner-on and pump-on, while the upper probe establishes pump-off position. The probes control relays to activate and deactivate the pump and the burner low water cut-off.



The three probes are mounted solidly in a metal plate, eliminating the need for a bellows seal. The probe mounting configuration maintains the same burner and pump differential settings throughout the entire system pressure and temperature range – even at lower pressures.

DIFFERENTIALS

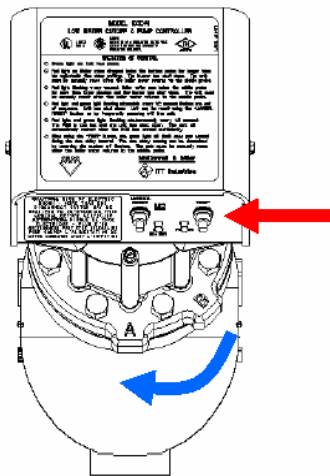
The differentials are the same for 150 psi as they are for 15 psi. Standard burner and pump differentials are the same as the float-actuated Series 150's operating at 150-psi. The result is a reduction of rapid burner cycling, which leads to more consistent and cost effective operation at lower boiler pressures. Surging water conditions are less of a problem for nuisance shutdowns due to the constant differential. A boiler will be less likely to experience nuisance shutdowns even with fairly large water line swing (up to 2 inches) caused by surging water conditions.

Adjustable Time Delay in Burner-Off circuit

The Burner-off differential can be altered by adjusting a time delay on the lowest probe from 0-60 seconds. If a water line surges more than 2 inches, adjusting the time delay in the burner off circuit will allow the burner to continue running even if the water line temporarily drops below the low water cut-off probe (lowest probe). A temporary drop in the water line is acceptable, in most cases, and it is desirable not to shut down the boiler in such situations, so overall boiler efficiency can be maintained. Loss in boiler efficiency costs money.

Applications such as vertical tubeless, small fire tube and process boilers are particularly susceptible to volatile water lines. The 150E offers flexibility to tune to the LWCO to the situation by adjusting the burner time delay. Small bounces in the water line may require a small burner time delay adjustment (say 5 seconds) while larger swings may require 30 seconds of burner off time delay. The 150E puts greater burner control in the hands of the user.

Adjustable Pump Differential



Rotating the entire Series 150E head assembly on the casting bolt circle flange one bolt position clockwise to the 'B' tab position (blue arrow), raises the pump-off probe an additional 7/16 inch – from the factory set 3/4 inch to 1 3/16 inch. This gives the user the ability to fine-tune the control for applications with a surging water line.

A surging water line can cause rapid cycling of the pump, even with the 150E at its initial factory settings. This can lead to increased pump maintenance cost due to excessive pump cycling. Setting the pump differential in the maximum position can save money by reducing maintenance costs.

DIAGNOSTIC LIGHTS

The Series 150E features internal and external diagnostic lights (red arrow above) to indicate system conditions such as low water, power on, 'water on' probe and probe 'out of sequence'. This allows for easy determination of system status and aids troubleshooting, if needed.

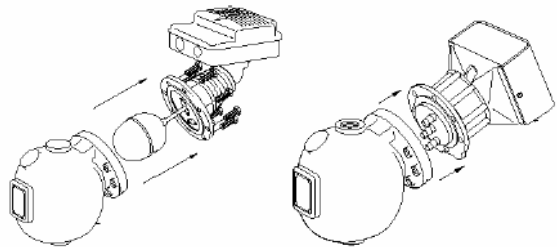
BUILT-IN RELAYS

Two 15 amp relays are included in the series 150E – in the pump and in the burner circuit. This allows switching up to 1-horsepower motors directly without a starter, thus saving additional installation expense. Also, the Series 150E-HD can directly replace the Series 150 & 150S without worrying about over amperage conditions on the switch.

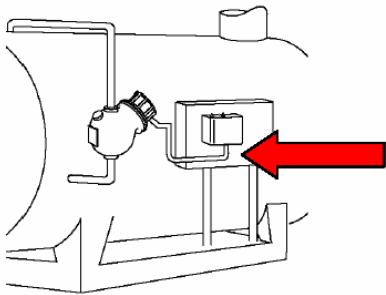
This capability is particularly important when converting from a Series 150 mercury control to a Series 150E. Installers have periodically violated the 7.4 amperage load specification for the switches. A 150E conversion can handle oversized pumps (i.e. ½ HP, ¾ HP, or greater) or overloaded burner circuits.

REPLACING SERIES 150 HEADS

The 150E head assemblies can directly replace current Series 150 or 150S head assemblies in field applications as all units have the same head mounting bolt circle. However, since the 150E requires power, two additional wires are needed to power the control. Details and specifications are covered in installation instructions MM-414 and MM-415 (available on our website, www.mcdonnellmiller.com).



CONTROL BOX MOUNTING



Another feature of the Series 150E is the ability to remove the electronic control box from the 150E unit and mount it remotely in a location closer to ground level. In many cases, with larger boilers, the Series 150E will be installed 8 to 12 feet off the ground, which makes access to the control very difficult. By locating the control box closer to ground level, users have convenient access to the test, manual reset and diagnostic features of the Series 150E.

SERIES 150E ISSUES

McDonnell & Miller has received reports of customers who have concerns with the Series 150E controls. Most of these situations occur when the customer's application required large quantities of fresh make-up water (due to system leaks or process requirements) that was not chemically treated and/or combined with poor boiler/system maintenance. This combination can lead to coatings developing on the probes which 'fool' the probe into thinking that either water is on the probe when it is not, or there is no water on the probe, when there is. Changing to a more aggressive chemical treatment may lead to a coating build-up on the probes from residue within the boiler system. Proper boiler maintenance (blowdowns) and more frequent cleaning of the probes are required in these situations. If the probes are kept clean due to these actions, the Series 150E will properly monitor the boiler water level.

SERIES 150E SUMMARY

Series 150E have expanded functionality, as compared to the float-operated 150/150S controls, while solving many of the inherent limitations of float-operated controls. The Series 150E can be considered a problem solving control in applications where current float operated controls do not perform adequately. For example, the 150E better fits boiler applications with rapidly changing water lines like vertical tubeless, water tube and even small fire tube boilers. Applications requiring burner and pump differentials between one to two inches are ideal candidates for the 150E products.

Because the 150E is not sensitive to system pressure changes, operating differentials remain unchanged whether the pressure is 0 psi or 150 psi. As a result, rapid burner or pump cycling can be reduced considerably and should no longer be of concern.

Series 150E controls may not be the best choice for applications where a large amount of fresh, untreated make-up water is required due to process applications or system problems, such as system leaks, if the user does not perform proper water treatment on a regular basis or if prescribed boiler maintenance and control blowdowns are not performed on a regular basis.

COMPARISONS BETWEEN THE SERIES 150E AND 150S

BURNER DIFFERENTIAL

Series 150E - Burner differential unaffected by changes in boiler pressure

- Solid mounting of the probes in a metal plate produces a burner differential that remains unaffected by changes in boiler pressure.
- Differential is the same as the Series 150S units at 150 psi.

Series 150S - Burner differential is affected by changes in boiler pressure

- Higher boiler pressure 'stiffens' the bellows producing larger differentials
- Differentials are set at the factory for 150 psi
- 'MD' models are available to compensate for the smaller differentials at lower pressures, and are recommended for boiler operating pressures below 50 psi.

BURNER-OFF TIME DELAY

Series 150E - Field-adjustable time delay built in

- Field adjustable (0 to 60-second) time delay in the burner off circuit allows the burner to continue running even if the water line temporarily drops below the low water cut-off probe (lowest probe).
- Ideal for boilers with water line surges of greater than 2 inches, such as vertical tubeless, small fire tube and process boilers which are particularly susceptible to volatile water lines.

Series 150S –No time delay

PUMP DIFFERENTIAL

Series 150E - Pump differential remains unchanged as system pressures fluctuate, but can be adjusted.

- Solid mounting of the probes in a metal plate produces a pump differential that remains unaffected by changes in boiler pressure.
- Factory set with the differential the same as the Series 150S units at 150 psi.
- Two pump differentials available by rotating the head on the flange one bolt position clockwise. Changes the differential from the factory setting at $\frac{3}{4}$, inch to 1-3/16 inch.

Series 150S - Pump differential is affected by changes in boiler pressure

- Higher boiler pressure ‘stiffens’ the bellows producing larger differentials
- Differentials are set at the factory for 150 psi

PUMP MOTOR STARTER RELAY

Series 150E - Built-in relays that are rated to 15 amps.

- Allows switching up to 1-horsepower motors directly without a starter.
- Allows easy conversion from Series 150 mercury controller to a Series 150E without concern for overloaded pump or burner circuits

Series 150S – No built-in starter relay

- Depending on the controlled pump motor horsepower and pump amperage draw, a separate starter relay may be required to be wired into the pump circuit.

SUMMARY

Two Series of LWCO controls (Series 150S and Series 150E) are available as alternatives for Series 150 LWCO controls that contain mercury switches. The chart on page 15 shows specific 150E or 150S LWCO alternatives for Series 150 units that contain mercury. Please keep in mind that in a replacement or repair situation you do not have to change out the entire control. A head replacement (i.e. 150E-HD or 150S-HD) is all that's required.

Which 'BEST' alternative control chosen, either a 150S or a 150E, depends on a number of factors:

- Application/situation matched to the control's characteristics
 - Boiler/system operating pressure
 - Fluctuating water line
 - System maintenance/procedures
- Expense:
 - LWCO control cost
 - Additional wiring that may be required for 150E controls
 - Additional starters that may be required for 150S controls

It is important to understand that regardless of which control is used (Series 150E or 150S), there are requirements that lead to the best performance of ALL level controllers and LWCO's:

- Use of properly-sized pump starters/relays in the pump control circuitry
- Pumps that are balanced to the system requirements
- Equalizing piping, per the boiler manufacturer's recommendations, to properly sense the boiler water level
- Industry accepted blowdown piping to provide best cleaning action of the control chamber, float linkage mechanism and/or probes
- Proper periodic blowdown of the boiler controls
- Proper chemical treatment of boiler water
- At least annually cleaning and careful examination of the float mechanism, probes, and electrical switches or controls. More frequent cleaning may be required for exceptionally dirty steam systems.

APPLICATIONS / SITUATIONS WHEN TO USE

Series 150S controls

- Systems with relatively stable or small fluctuations in water line
- When no new electrical wiring is desired or possible
- When boiler feed pump is balanced to system requirements

Series 150E controls

- Boiler/systems with rapidly changing water lines of 1 – 2 inches
- Systems where rapid burner or pump cycling has been a past problem
- Lower pressure systems where it is important to maintain consistent pump differentials

APPLICATIONS / SITUATIONS WHEN NOT TO USE

Series 150S controls

- If boiler water line has a lot of movement
- If user does not want to install a starter / contactor for starting the boiler feed pump

Series 150E controls

- If a large amount of fresh, untreated make-up water is required due to system problems (i.e. system leaks)
- If proper, consistent water treatment is not performed on a regular basis
- If prescribed boiler maintenance and control blowdowns are not performed on a regular basis

SPECIFIC MODEL ALTERNATIVES FOR SERIES 150 MERCURY UNITS

M&M Products Containing Mercury		M&M Mercury-Alternative Products			
End Item	Description	End Item	Description	End Item	Description
171700	150	171600	150E	171702	150S
171704	150-F	171600	150E	171705	150S-F
171800	150 MD	171600	150E	171802	150S-MD
171900	150B MD	171600	150E	171903	150S-B
172000	150B MD	171600	150E	172002	150S-B-MD
172100	150BM	171610	150E-M	172104	150S-B-M
172102	CB-150-BM	171610	150E-M	172107	CB-150S-BM
172200	150BM MD	171610	150E-M	172201	150S-BM-MD
172300	150-F-HD	171640	150E-HD	172301	150S-F-HD
172600	150J	171601	150E-J	172601	150S-J
172650	150JY	171601	150E-J	172641	150S-JY
172653	150JY-3	171601	150E-J	172642	150S-JY3
172700	150M	171610	150E-M	172702	150S-M
172800	150M MD	171610	150E-M	172802	150S-M-MD
172900	150MJ	171611	150E-M-J	172901	150S-M-J
173000	150-HD	171640	150E-HD	173003	150S-HD
173100	150-MD-HD	171640	150E-HD	173103	150S-MD-HD
173200	150-M-HD	171650	150E-M-HD	173203	150S-M-HD
173300	150-M-MD-HD	171650	150E-M-HD	173302	150S-M-MD-HD
173500	157	171620	157E	173502	157S
173600	157 MD	171620	157E	173603	157S-MD
173700	157A	171622	157E-A	173702	157S-A
173800	157AM	NONE		173802	157S-A-M
175400	157M	171630	157E-M	175402	157S-M
175410	157M MD	171630	157E-M	175412	157S-M-MD
175800	157P	171621	157E-P	175802	157S-P
176200	157R	171623	157E-R	176220	157S-R
176202	157R MD	171623	157E-R	176222	157S-R-MD
176211	157P MD	171621	157E-P	176223	157S-P-MD
176501	157RBP MD	171628	157E-RBP	176503	157S-RBP-MD
176502	157M RBP MD	NONE		176504	157S-M-RBP-MD
176550	157RBM	NONE		176551	157S-RB-M
176600	157RB MD	171624	157E-M	176601	157S-RB-MD
176800	157RD MD	171625	157E-RD	176802	157S-RD-MD
176900	157RL	171626	157E-RL	176902	157S-RL
177000	157RLM	171636	157E-RLM	177006	157S-RL-M
177002	CB-157-RLM	171636	157E-RLM	177008	CB-157S-RLM
177250	157RLS MD	171627	157E-RLS	177251	157S-RLS-MD
177300	157RM	171633	157E-RM	177306	157S-R-M
177302	CB-157-RM	171633	157E-RM	177308	CB-157S-RM
178000	157R158HD	171623	157E-R	178001	157R158S-HD
178200	157R159HD	171623	157E-R	178201	157R159S-HD
178350	157RL159HD	171623	157E-R	178351	157RL159S-HD
178400	158	171600	150E	178402	158S
178500	158M	171610	150E-M	178502	158S-M
178600	158-HD	171640	150E-HD	178602	158S-HD
178700	158-M-HD	171650	150E-M-HD	178702	158S-M-HD
178800	159	171600	150E	178802	159S
178900	159-HD	171640	150E-HD	178902	159S-HD
310456	150-JY-HD	310486	150S-JY-HD	171640	150E-HD
310457	150-JY-3-HD	310487	150S-JY3-HD	171640	150E-HD
348100	SA150-124	NONE		171640	150E-HD
348200	SA150M-124	NONE		171640	150E-HD
348300	SA150-125	NONE		171640	150E-HD