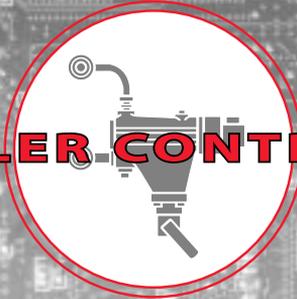


1998-99

GENERAL
CATALOG
MM-825

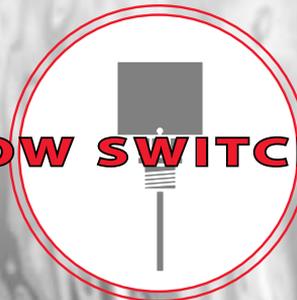
BOILER CONTROLS



LIQUID LEVEL CONTROLS



FLOW SWITCHES



For Residential, Industrial and
Commercial Applications





McDonnell & Miller

ITT McDonnell & Miller – the industry leader. Delivering reliable performance and safety in boiler and level control products for over 70 years.

Whether it's ease of serviceability, continuous improvement, product enhancements or interchangeability, ITT McDonnell & Miller is continually doing more to give you the best performing residential, commercial and industrial liquid level and flow control products found anywhere.

**BOILER CONTROLS
FLOW SWITCHES
LIQUID LEVEL
CONTROLS**

**ITT McDONNELL & MILLER IS AN
INTERNATIONALLY CERTIFIED
ISO 9001 & 14001 ORGANIZATION**



ITT McDonnell & Miller is the recipient of the highly coveted "ISO 9001 & 14001" Certification. Recognized by more than 50 countries, these worldwide standards provide a uniform measure of quality procedures in manufacturing and service organizations.

Participation in the rigid and demanding ISO 9000 & 14001 Certification process is one of our most important activities. We want our customers and competitors – both in the United States and abroad – to know that we are dedicated to designing, producing and marketing the very highest quality products available anywhere.

HOW TO USE THIS CATALOG

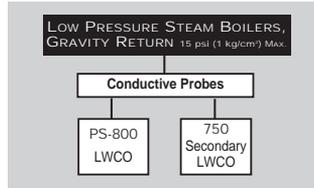
This guide will assist you in your tour of the McDonnell & Miller General Catalog. The information contained in the catalog is organized into 5 key categories:

- System Selection Chart
- Product Selection Guide
- Basic System Operation
- Products
- Technical Information and Specifications

Easy to identify symbols and product icons will help you specify and select the product that meets your requirements.

SYSTEM SELECTION CHART...

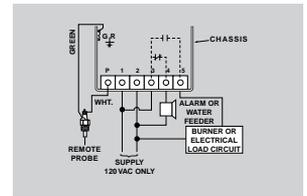
...a flow chart to help you find the appropriate products that work within a specific system type.



TECHNICAL INFORMATION AND SPECIFICATIONS...

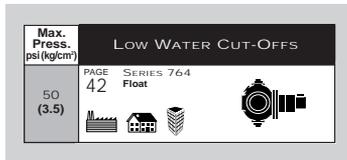
...full of helpful data to assure your selection is the right one.

BASIC WIRING



PRODUCT SELECTION GUIDE...

...a quick reference that groups together products by specific categories. Designed for those who know their system requirements, just look for the associated application and product icons.



CONVERSIONS & FORMULAS

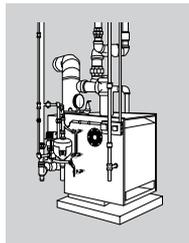
$$\frac{\text{Lbs. of Water}}{8.33} = \text{Gallons of Water}$$

APPROVAL AGENCIES



BASIC SYSTEM OPERATION...

...the encyclopedia of boiler operation. An easy-to-read, informative guide to all the basic elements that make steam and hot water boiler systems work.



GLOSSARY OF TERMS

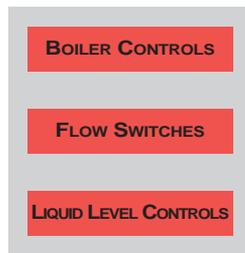
... a detailed description of all terms that appear in this catalog.

WARRANTY & RETURN POLICY



PRODUCTS...

...the complete McDonnell & Miller product line, divided into 3 primary groups:



Just check the **CONTENTS** pages for the associated product icons to quickly find the control you need.

MAINTENANCE & REPLACEMENT INTERVAL GUIDELINES...

...the easy to read guides will help keep you on track with suggested product maintenance and replacement intervals.

Recommended Replacement Intervals

Product	Series	Recommended Maintenance	Recommended Replacement Interval (Maximum)
Low Water Cut-Offs	150, 157, 158, 159, 160, 167, 168, 169	Blow down and test daily	15 years
	69, 169, 269, 269, 469	Inspect and test annually.	10 years
	67, 767, 70, 70-B	Blow down weekly. Inspect and test annually.	10 years
	61, 63, 64, 764	Blow down weekly. Inspect and test annually.	10 years
	42	Blow down daily. Inspect and test annually.	10 years

System Selection Chart7
 Product Selection Guide9
 Basic System Operation13
 Products: *Boiler Controls*31
 Flow Switches102
 Liquid Level Controls143

Technical Information and Specifications
 Basic Wiring161
 Conversions & Formulas174
 Approval Agencies175
 Glossary of Terms176
 Warranty & Return Policy179
 Maintenance180

BOILER CONTROLS

LOW WATER CUT-OFFS	SERIES	PAGE
• For Hot Water Boilers		
Electronic	750 	33
	PS-850 	34
NEW 	RB-24 	32
NEW 	RB-120 	35
Float Type	63 	36
	64 	37
	764 	38
• For Steam Boilers		
Electronic	750 	40
	PS-800 	41
Float Type	61 	42
	63 	43
	64 	44

LOW WATER CUT-OFFS	SERIES	PAGE
• For Steam Boilers (Float Type continued)		
	67 	46
	69 	48
	70 	49
	150 	51
NEW	150S 	50
	157 	53
NEW	157S 	52
	764 	45
	767 	47
• Combination Low Water Cut-Off/ Pump Controllers for Steam Boilers		
	42 	54
	93 	55
	94 	58

BOILER CONTROLS (continued)

<u>LOW WATER CUT-OFFS</u>	<u>SERIES</u>	<u>PAGE</u>	<u>WATER FEEDERS</u>	<u>SERIES</u>	<u>PAGE</u>
<ul style="list-style-type: none"> • Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (continued) 					
	150	 61		221	 76
	150S	 60		551-S	 78
	157	 63		847	 79
	157S	 62		851	 80
	193	 56	<ul style="list-style-type: none"> • Combination Mechanical Water Feeder/ Low Water Cut-Offs 		
	194	 59		47-2	 81
<u>WATER FEEDERS</u>	Uni-Match®	 66		51-2	 85
• Electric	101-A	 67		51-S-2	 86
• Mechanical	47	 68		53-2	 87
	51	 72		247-2	 83
	51-S	 73	<u>REPLACEMENT HEAD MECHANISMS</u>		
	53	 74		25-A	 90
	247	 70		42	 88
• Make-Up	21	 76		51	 90
	25-A	 77		51-S	 91

BOILER CONTROLS (continued)

REPLACEMENT HEAD MECHANISMS (CONT.)

SERIES	PAGE
53 	91
61 	88
63 	88
64 	89
67 	89
70 	89
93 	89
94 	89
150 	90
NEW 150S 	90
157 	90
NEW 157S 	90
193 	89
194 	89
764 	89
767 	89

SWITCHES

SERIES	PAGE
2 	92
5 	93
7-B 	94
11 	95

VALVES

- *Blow Down*

14-B 	96
--	----

- *Cartridge & Strainer*

CTRD 	97
--	----

- *Test-N-Check®*

TC-4 	98
--	----

- *Pressure Relief*

250 	99
--	----

260 	101
---	-----

FLOW SWITCHES

LIQUID FLOW

• *General Purpose*

SERIES		PAGE
FS4-3		110
FS4-3F		110
FS4-3T		112
FS5		114
FS8-W		115

• *High Sensitivity*

FS1		117
FS1-W		118
FS6		119
FS6-W		119

LIQUID FLOW (CONT.)

• *Industrial*

SERIES		PAGE
FS7-4		121
FS7-4A		123
FS7-4E		125
FS7-4F		121
FS7-4W		127

AIR FLOW

AF1		133
AFE-1		135
AF2		137
AF3		138

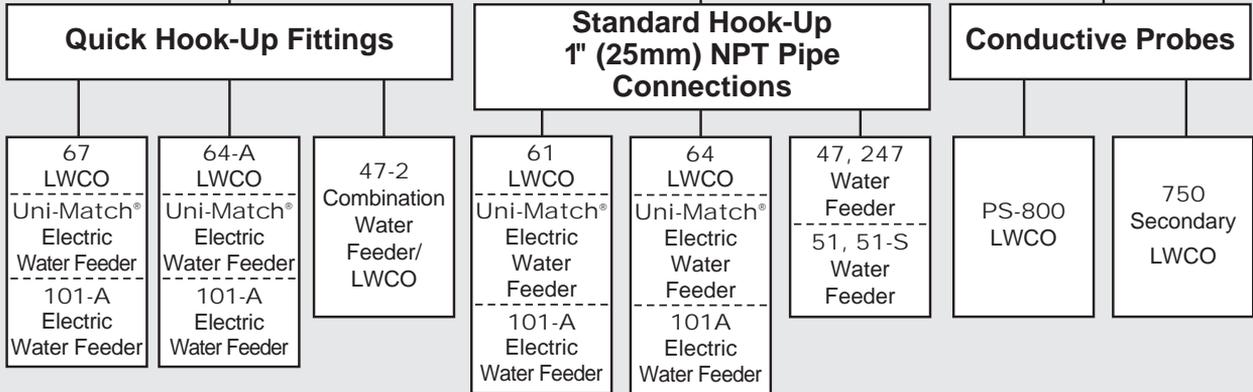
FLOW SWITCH TIME DELAY RELAYS

T-5-R		140
T-20		141

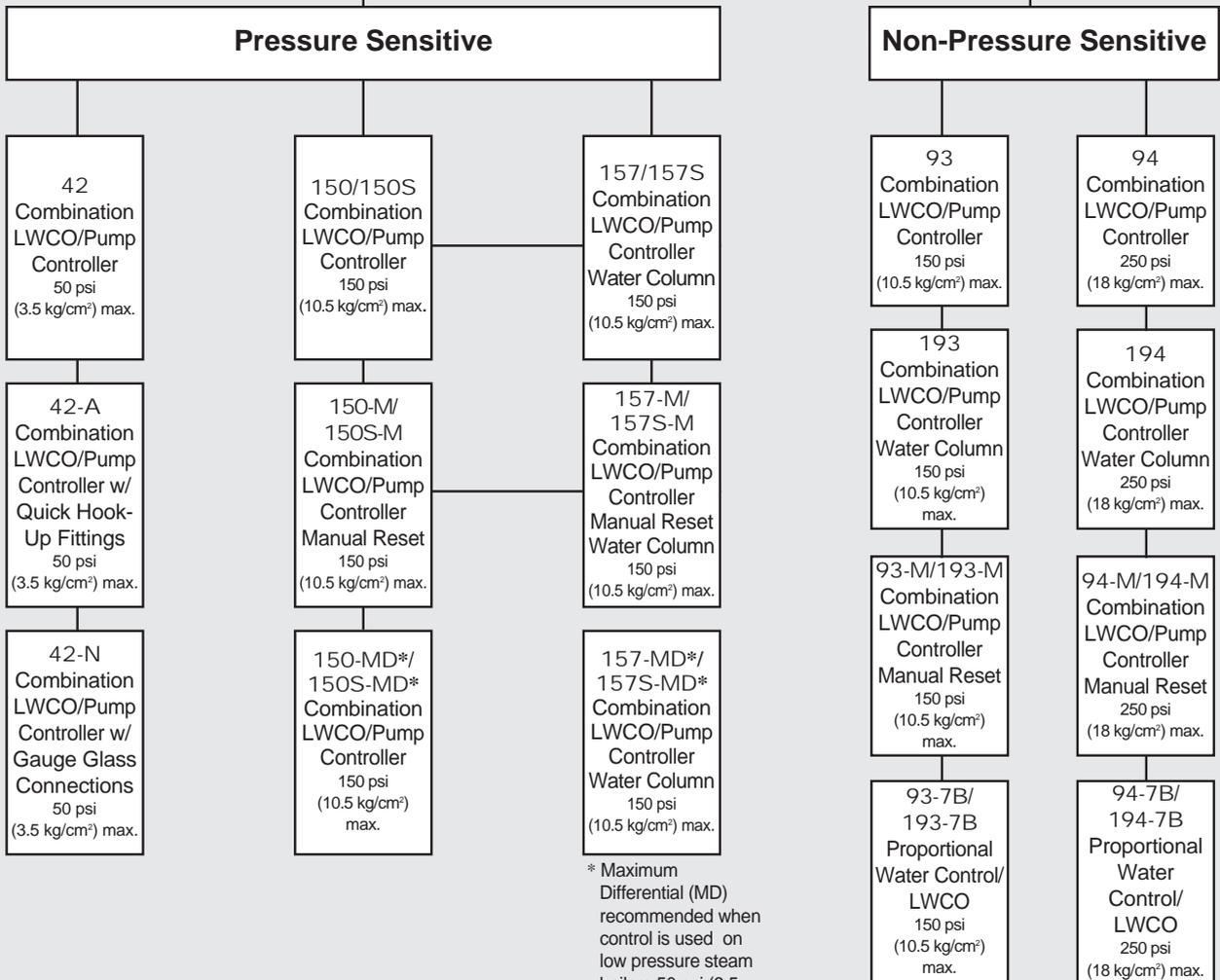
LIQUID LEVEL CONTROLS

<u>CONDUCTANCE ACTUATED (PROBE TYPE)</u>	<u>SERIES</u>	<u>PAGE</u>	<u>FLOAT ACTUATED (CONT.)</u>	<u>SERIES</u>	<u>PAGE</u>
<ul style="list-style-type: none"> • <i>Special Purpose</i> 	PS-850	 143		18	 155
<ul style="list-style-type: none"> • <i>General Purpose</i> 	<div style="display: flex; align-items: center;"> <div style="background-color: black; color: white; padding: 2px 5px; transform: rotate(-15deg); font-weight: bold; margin-right: 5px;">NEW</div> <div> <p>LPC-2000</p> <p style="text-align: center;"></p> </div> </div>	144		18-SS	 156
	PCH	 146		27-W	 157
	PCL	 146		65	 158
<u>FLOAT ACTUATED PNEUMATIC</u>	PFC	 150		80	 154
<u>FLOAT ACTUATED</u>	VFS	 157		165	 159
	E-8	 153		518	 155
				3155	 160

**LOW PRESSURE STEAM BOILERS,
GRAVITY RETURN 15 psi (1 kg/cm²) MAX.**



**HIGH AND LOW PRESSURE STEAM BOILERS,
PUMP RETURN (Pump Controllers Required)**



HOT WATER BOILERS

63
LWCO
50 psi
(3.5 kg/cm²) max.

64
LWCO
50 psi
(3.5 kg/cm²) max.

764
LWCO
50 psi
(3.5 kg/cm²) max.

150/150S
Combination
LWCO/Pump
Controller
150 psi
(10.5 kg/cm²)

247-2
Combination
Water Feeder/
LWCO
30 psi
(2 kg/cm²) max.

51-2
Combination
Water Feeder/
LWCO
35 psi
(2.5 kg/cm²) max.

51-S-2
Combination
Water Feeder/
LWCO
35 psi
(2.5 kg/cm²) max.

53-2
Combination
Water Feeder/
LWCO
75 psi
(5 kg/cm²) max.

PS-850
Conductance
Probe
160 psi
(11 kg/cm²) max.

RB-24
Conductance
Probe
50 psi
(3.5 kg/cm²) max.

RB-120
Conductance
Probe
160 psi
(11 kg/cm²) max.

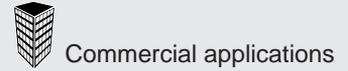
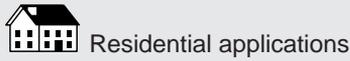
750
Conductance
Probe
250 psi
(18 kg/cm²) max.

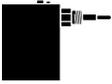
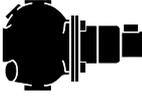
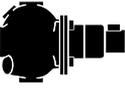
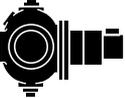
Forced Circulation Water Tube Boilers

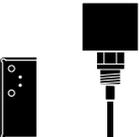
FS4-3
Flow Switch
150 psi
(10.5 kg/cm²)
max.

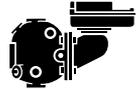
FS7-4
Flow Switch
300 psi
(21 kg/cm²) max.

FS8-W
Flow Switch
150 psi
(10.5 kg/cm²)
max.



Max. Press. psi (kg/cm ²)	LOW WATER CUT-OFFS	
15 (1)	PAGE 41	SERIES PS-800 Electronic  For Steam Boilers
20 (1.4)	PAGE 42	SERIES 61 Float  For Steam Boilers
	PAGE 46	SERIES 67 Float  For Steam Boilers
	PAGE 47	SERIES 767 Float  For Steam Boilers
50 (3.5)	PAGE 48	SERIES 69 Built-In Float  For Steam Boilers
	PAGE 49	SERIES 70 Float  For Steam Boilers
	PAGE 43	SERIES 63 Float  For Steam or Hot Water Boilers
50 (3.5)	PAGE 44	SERIES 64 Float  For Steam or Hot Water Boilers
	PAGE 45	SERIES 764 Float  For Steam or Hot Water Boilers
PAGE 32	SERIES RB-24 Probe  For Hot Water Boilers	

Max. Press. psi (kg/cm ²)	LOW WATER CUT-OFFS	
160 (11)	PAGE 35	RB-120 Electronic  For Hot Water Boilers
250 (18)	PAGE 33	SERIES 750 Electronic  For Hot Water Boilers
160 (11)	PAGE 34	SERIES PS-850 Electronic  For Hot Water Boilers

Max. Press. psi (kg/cm ²)	COMBINATION LOW WATER CUT-OFF/PUMP CONTROLLER	
50 (3.5)	PAGE 54	SERIES 42 Float  For Steam Boilers
150 (10.5)	PAGE 51	SERIES 150 Float  For Steam Boilers
	PAGE 50	SERIES 150S Float  For Steam Boilers
	PAGE 63	SERIES 157 Float  For Steam Boilers
250 (18)	PAGE 62	SERIES 157S Float  For Steam Boilers
	PAGE 55	SERIES 93 Float  For Steam Boilers
PAGE 56	SERIES 193 Float  For Steam Boilers	
250 (18)	PAGE 58	SERIES 94 Float  For Steam Boilers
PAGE 59	SERIES 194 Float  For Steam Boilers	



Industrial applications



Residential applications



Commercial applications

Max. Press. psi (kg/cm ²)	PROPORTIONAL WATER CONTROL/LOW WATER CUT-OFFS	
150 (10.5)	PAGE 55 SERIES 93-7B Float PAGE 56 SERIES 193A-7B Float	<p>For Steam Boilers</p>
250 (18)	PAGE 58 SERIES 94-7B Float PAGE 59 SERIES 194-7B Float	<p>For Steam Boilers</p>

Max. Press. psi (kg/cm ²)	ELECTRIC WATER FEEDERS	
15 (1)	PAGE 66 UNI-MATCH®	<p>For Steam Boilers</p>
25 (1.8)	PAGE 67 MODEL 101-A	<p>For Steam Boilers</p>

Max. Press. psi (kg/cm ²)	COMBINATION MECHANICAL WATER FEEDER/LOW WATER CUT-OFFS	
25 (1.8)	PAGE 81 SERIES 47-2	<p>For Steam or Hot Water Boilers</p>
30 (2.1)	PAGE 83 SERIES 247-2	<p>For Steam or Hot Water Boilers</p>
35 (2.5)	PAGE 85 SERIES 51-2 PAGE 86 SERIES 51-S-2	<p>For Steam or Hot Water Boilers</p>
75 (5)	PAGE 87 SERIES 53-2	<p>For Steam or Hot Water Boilers</p>

Max. Press. psi (kg/cm ²)	MECHANICAL WATER FEEDERS	
25 (1.8)	PAGE 68 SERIES 47	<p>For Steam or Hot Water Boilers</p>
30 (2.1)	PAGE 70 SERIES 247	<p>For Steam or Hot Water Boilers</p>
35 (2.5)	PAGE 72 SERIES 51 PAGE 73 SERIES 51-S	<p>For Steam or Hot Water Boilers</p>
75 (5)	PAGE 74 SERIES 53	<p>For Steam or Hot Water Boilers</p>



Industrial applications



Residential applications



Commercial applications

Max. Press. psi (kg/cm ²)	MAKE-UP WATER FEEDERS	
25 (1.8)	PAGE 78	SERIES 551-S For Steam Separators, Receivers, Tanks or other Vessels
35 (2.5)	PAGE 76	SERIES 21 SERIES 221 For Boiler Receiver Tanks
	PAGE 77	SERIES 25-A For Steam Boilers
100 (7)	PAGE 80	MODEL 851-S For Steam or Hot Water Boilers
150 (10.5)	PAGE 79	MODEL 847 For Receiver Tanks
	PAGE 80	MODEL 851 For Steam or Hot Water Boilers

Max. Press. psi (kg/cm ²)	FLOW SWITCHES (LIQUID FLOW)	
150 (10.5)	PAGE 110	SERIES FS4-3
	PAGE 114	SERIES FS5
100 (7)	PAGE 115	SERIES FS8-W Float
300 (18)	PAGE 117	SERIES FS1
1000 (70)	PAGE 119	SERIES FS6
300 (18)	PAGE 121	SERIES FS7-4
1000 (70)	PAGE 121	SERIES FS7-4S

Flow fpm (m/min)	FLOW SWITCHES (AIR FLOW)	
480-2230 (146-680)	PAGE 133	MODEL AF1 Medium/High Velocity
300-1950 (91-594)	PAGE 135	MODEL AFE-1 Medium Velocity
380-1250 (116-381)	PAGE 137	MODEL AF2 Low Velocity
235-1470 (72-448)	PAGE 138	MODEL AF3 Low Velocity MODEL AF3-D Low Velocity

SYSTEM SELECTION CHART



Industrial applications



Residential applications



Commercial applications

SYSTEM SELECTION CHART

Max. Press. psi (kg/cm ²)	LIQUID LEVEL CONTROLS	
5 (.4) Fuel Oil	PAGE 154 SERIES 80 Float	
	PAGE 153 SERIES E8 Float	
15 (1)	PAGE 160 SERIES 3155	 For Solvent Stills
35 (2.5)	PAGE 157 SERIES 27-W	
50 (3.5) Liquid	PAGE 158 SERIES 65 Float	
	PAGE 159 SERIES 165 Float	

Max. Press. psi (kg/cm ²)	LIQUID LEVEL CONTROLS	
100 (7)	PAGE 155 SERIES 18	
	PAGE 156 SERIES 18-SS	
155	PAGE 155 SERIES 518	
160 (11) Hot Water	PAGE 143 SERIES PS-850 Conductance	
	PAGE 144 SERIES LPC-2000 Conductance	
250 (18) Liquid	PAGE 146 MODEL PCH Conductance MODEL PCL Conductance	
	PAGE 150 MODEL PFC Pneumatic	
	PAGE 151 MODEL VFS Float	

Steam Boilers

They've been with us for over two hundred years, and most of the time, they're so reliable most folks don't give them much thought. They sit in buildings all over the world, transferring heat from fuel to water, allowing us to warm our buildings or complete our processes.

Steam boilers are simple, efficient and reliable. No machine does a better job of moving BTUs from one place to another. We've used them for space heating since before the United States Civil War in 1861.

Even before the Civil War, we used steam boilers for industrial processes. Today we use them to run factories, press clothes, wash dishes, pasteurize milk, sterilize medical equipment, and to heat entire cities! Their capabilities seem endless.

But despite its simplicity, any steam boiler can run into trouble if its control system doesn't act properly. If the energy you put into the boiler exceeds what the boiler can absorb, the boiler can rupture. So you must always be on guard.

A simple safety relief valve of the right capacity and relief-pressure setting protects the boiler from over pressure. But over pressure isn't the only thing that can threaten a steam boiler. There are also the dangers of dry firing.

Should the internal water level drop too low, the boiler can burn out. So here too, you must always be on guard. You see, a steam boiler needs its water to move the heat away from its metal surfaces. Without the right internal level of water, heat quickly accumulates. Too much heat creates a very dangerous operating condition.

Boiler manufacturers have always set up minimum safe water level requirements for their equipment. Our controls help enforce those requirements in two ways:

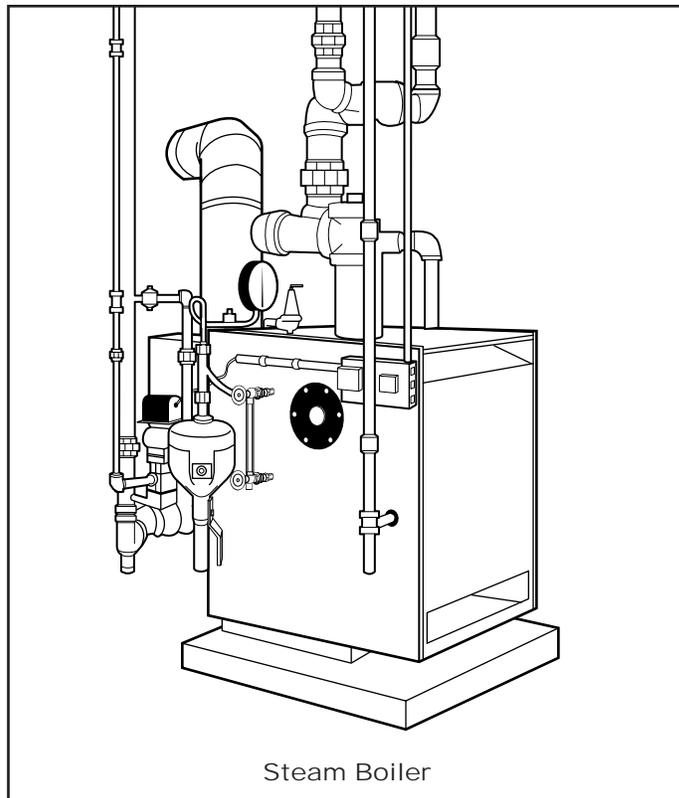
- By maintaining a minimum safe water level in the boiler.
- By signaling the burner to stop should the water level drop below that point.

In this brief Systems Guide we will explain how we do these two very important jobs.

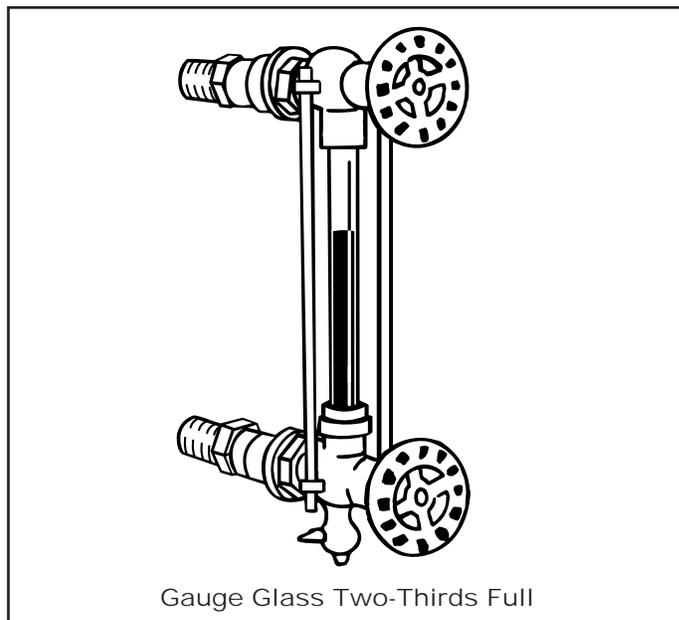
What's a "Normal" Water Level?

The proper steam boiler water level varies from manufacturer to manufacturer, but generally, we can say that it's "normal" to start by manually filling the boiler to the two-thirds-full point on the gauge glass. As the boiler operates, the water will quickly turn to steam and head out toward the system.

Steaming takes place at a constant rate of about one-half gpm per 240,000 BTU/HR (D.O.E. Heating Capacity



Steam Boiler



Gauge Glass Two-Thirds Full

Rating). This is a law of physics so it doesn't vary from manufacturer to manufacturer. If you're working with a boiler with a rating of, say, 1,000,000 BTU/HR, you can be assured the water is turning to steam and leaving that boiler at the rate of about two gpm. And it's leaving at speeds measured in miles per hour (sometimes exceeding 60 mph!). So it's very important for your near-boiler piping to be correct. If it's not, the fast moving steam will pull water out of the boiler and create problems for you in the system and the boiler.

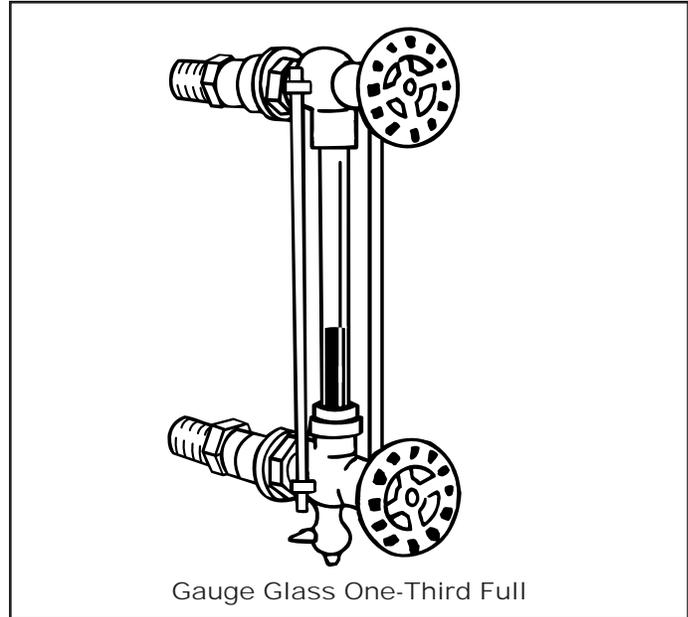
As the water (in the form of steam) heads out toward the system, the water level in the boiler will, of course, drop. How far it drops, depends a lot on the size and condition of your piping system. You see, *ideally*, the water should begin to return to the boiler before the boiler's internal water line drops to a critical point. That's the point at which the low water cut-off will cut power to the burner, or an automatic water feeder will open.

Because the water is in the system piping and radiating during operation, the "normal" water level becomes a point that's somewhere in the lower-third of the gauge glass.

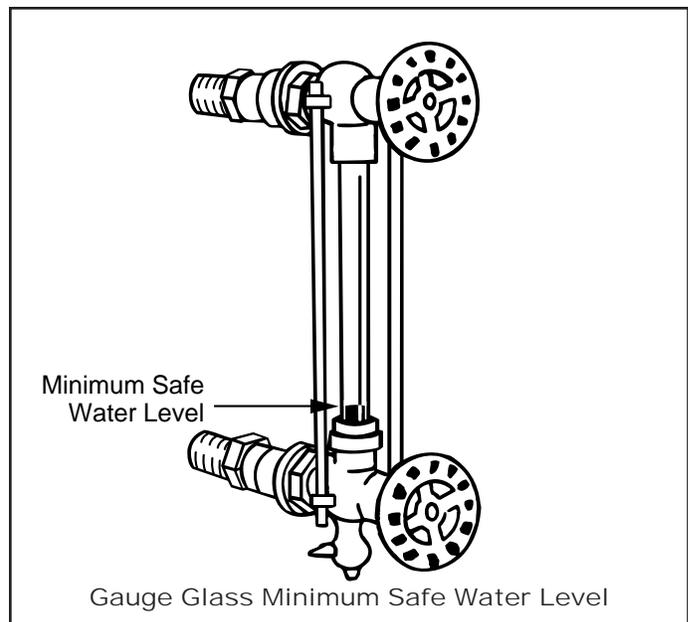
Remember, you're working with a *range* of operation here, not a fixed point. If the water were to stay at the top of the gauge glass all the while the burner was firing, you probably wouldn't be making steam! So don't get too caught up with the word "normal" because the only thing that's normal is that the water level will rise and fall.

Boiler manufacturers, as we said before, *do* establish a minimum safe water level for their boilers, however. That point is usually just out of sight of the bottom of the gauge glass. Should the water level drop to this point, the boiler may be in danger of overheating. We have to find a way to protect the boiler from itself.

All leading authorities and insurance companies recognize this need. The ASME Code for Low Pressure Heating Boilers, for instance, specifies, "*Each automatically fired steam or vapor steam boiler shall be equipped with an automatic low water fuel cut-off.*" The device the code refers to is what most people in the field commonly call a "low water cut-off." Its job is to stop the burner and protect the boiler.



Gauge Glass One-Third Full



Gauge Glass Minimum Safe Water Level

What Causes a Low Water Condition?

Because it's an open system, some evaporative water loss is normal for a steam system. How much depends on the size and condition of the system. If you're losing too much water, however, it's time to begin troubleshooting. There are many places to look.

Here are a few good places to start:

- The air vents are dirty, not seating properly, and passing steam to the atmosphere.
- Someone left the boiler blowdown valve partially open.
- Someone, for whatever reason, has been drawing hot water from the boiler.
- The relief valve has discharged.
- The condensate pump isn't working as it should.
 - The float may have come loose.
 - The condensate may be too hot to pump. (Check those steam traps!)
- Improper near-boiler piping may be throwing water up into the system, or causing the waterline to tilt during operation.
- The wet returns may be leaking. (Always suspect *any* buried pipe).
- A check valve may be stuck closed or partially closed.
- The boiler may be foaming and priming.
 - Check the pH of the water. It should be between 7 and 9.
 - Check the condition of the water. Dirty water will prime and foam.
 - Check the burner's firing rate. Over-firing can cause priming.
- The pipes may not be properly pitched.
- The automatic feeder may not be working properly.
 - Its chamber may be filled with sediment.
 - Its feed line may be clogged.
- All of the condensate may not be returning from the system (a common problem with process applications).
- The boiler metal may be corroded and leaking at the water line.
 - Flood the boiler to its header to check for leaks.

Good troubleshooters take the time to look over the entire system before deciding what's wrong. Take the time to do it right, and you'll be the person with the answers.

Watching the Water Level

The best way to prevent overheating damage to a boiler is to stop the burner if the water level falls too low. This is the low water cut-off's job. There are several types of low water cut-offs you can use. Let's look at them.

Float Operated Low Water Cut-Offs

Float operated low water cut-offs have been around since the 1920s and have earned a reputation worldwide for reliability. Usually, you'll mount this type of low water cut-off directly in the boiler's gauge glass tapplings. We make "quick hook-up" fittings for these units to simplify installation.



Series 67 Float Type Low Water Cut-Off

The water level in the low water cut-off's chamber will mimic the water level in the boiler. As the water level drops in the boiler during steaming, the level in the chamber, and the cut-off's float drops with it. Should the float drop to the boiler's critical low water cut-off point, the float will trip an electrical switch that's wired in series with the burner. The burner instantly stops firing. It will stay off until the water level rises to a safe operating point.

This happens when the condensate returns from the system or when an automatic water feeder or a boiler attendant adds water to the boiler. When the level reaches a safe position, the low water cut-off will make its electrical connection and the burner will restart.

When a steam system is well balanced, the low water cut-off's job is to stand by and wait. The situation we just described suggests that there's something out of balance in that system. We'll look at this again in a few minutes.

Probe and Float Type Built-In Low Water Cut-Offs

There are some jacketed boilers that don't easily accept quick hook-up fittings. These boilers will often have a tapping for a built-in low water cut-off. These built-in units do the same thing as the external units we just looked at, but instead of being in a chamber, the "built-ins" are right inside the boiler where they can sense the water level directly.

We make two types of built-in low water cut-offs:

Probes – The boiler manufacturer will specify the point where they'd like to have this type of low water cut-off inserted. It will usually sit just below the water line, at a point above the boiler's crown. A probe uses the boiler's water to complete an electrical circuit past an insulator (the center portion of the probe) back to a ground (the threaded portion of the probe). As long as water covers the probe an electronic "go" signal will travel to the burner. When water drops off the probe for a continuous ten seconds, an electronic "stop" signal goes to the burner, shutting it down and protecting the boiler from a low water condition.

At ITT McDonnell & Miller, we manufacture several different types of probe low water cut-offs to meet any of your job applications.

One of those applications might involve the boiler's water level. The water capacity of today's boilers is considerably less than that of boilers from decades ago. Along with this, the water level operating range of today's boilers is smaller. Further, the amplitude of surging water levels is increasing. As a result, the low water cut-off must be "smart" enough to recognize these variations and react appropriately. We have done this by



Series PS-800 Probe Type Low Water Cut-Off

incorporating delay features in the probe's operating logic. These include a delay on break feature (DOB) which keeps the burner lit for 10 seconds after water leaves the probe. This minimizes the effects of a surging water line. Another addition – the delay on make feature (DOM) – allows an additional feed time of 15 seconds once water comes in contact with the probe. This minimizes rapid burner and feeder cycling by slightly elevating the water level so that water lost to steaming will return (in the form of condensate) before the water level drops below the probe.

Float Type – In operation, these are similar to the external, float operated low water cut-offs we looked at before. The difference is that instead of sensing a duplicated water level *outside* the boiler, these units sense the level directly inside the boiler.

We make them for you in five mounting-barrel sizes (Series 69) to accommodate different boiler insulation thicknesses. When you select a built-in, float type control make sure it fits as far as possible into the boiler, without the float shield coming contact with the boiler.

When a low water cut-off stops a burner, it also stops the entire heating system. Nothing will happen until the water in the boiler returns to a safe operating level.

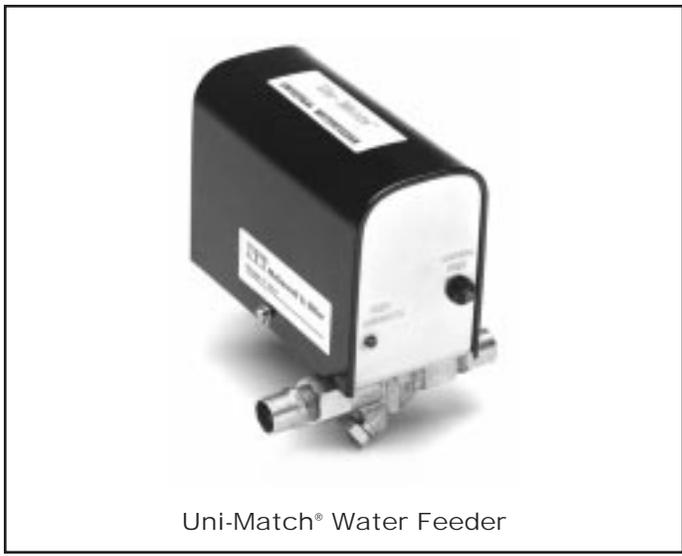
While this is very good for the boiler, it may not be the best thing for the system. If the heat in the building is off for too long a time, water pipes may begin to freeze.

This is where automatic water feeders come in. An automatic feeder will maintain a safe minimum water level in the boiler and keep it operating, even if the system is leaking. It keeps the system operating automatically until you can make the repairs.

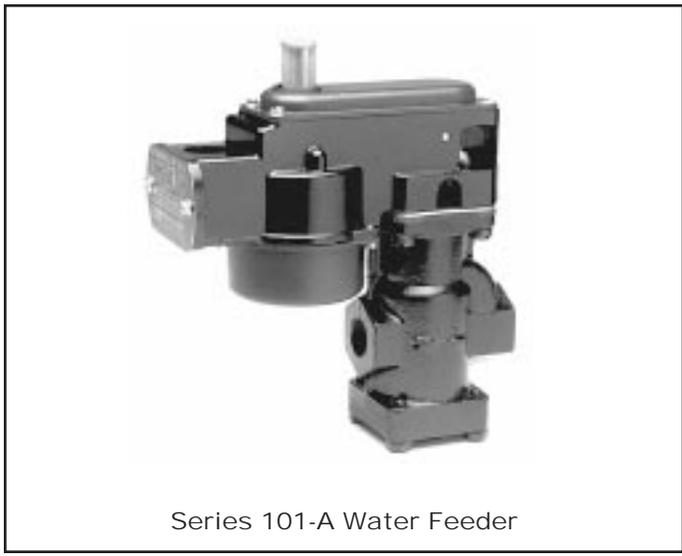
Combination Low Water Cut-Offs and Automatic Water Feeders

Two of our most popular and versatile feeders are the Uni-Match® and the 101A. These are ideal for use in residential or small commercial applications. They are versatile in that they are compact and they are easily installed to operate with either a probe type OR a float type low water cut-off. These feeders are always ready to add water when given the signal from the low water cut-off. The benefits they offer are the convenience of not having to manually add water – and most importantly – they will protect the boiler from a dry fire condition by maintaining a safe minimum water level in the boiler should a system leak occur.

If you use a mechanical automatic water feeder, you can keep your burner operating even during a power failure.



Uni-Match® Water Feeder



Series 101-A Water Feeder



Series 47-2 Combination Mechanical Water Feeder/Low Water Cut-Off

A mechanical feeder can also protect a boiler should a fuel-regulating device malfunction, causing the burner to lock in and stay there. Or suppose someone jumps-out a control, putting the burner on continuous operation. A mechanical automatic water feeder will continue to feed the boiler whenever the level drops to the “feed” point.

Under normal circumstances, the electrical low water cut-off (the second part of the feeder/cut-off combination) is always standing by, ready to shut off the burner should something go wrong with the automatic feeder.

An automatic water feeder doesn’t feed at the two-thirds full point on the gauge glass. You set this by hand when you first start the system. As we said before, the “normal” level will range up and down as the system operates. An automatic feeder will maintain a safe *minimum* water line only. By doing this, it will lessen the possibility of human error.

Consider this. A boiler attendant might put too much water in a steam boiler. He doesn’t have an automatic feeder and he’s tired of checking the water level every day so he fills the boiler to the two-thirds full point while it’s operating. When the condensate returns, the boiler floods. By adding water the attendant has limited the boiler’s steam-making space. Without enough room to break free of the water, the steam will now carry water up into the system piping. This leads to higher fuel bills, uneven heating, water hammer, scale formation in the boiler and burner short-cycling. Suddenly, problems plague this system, and no one is sure why.

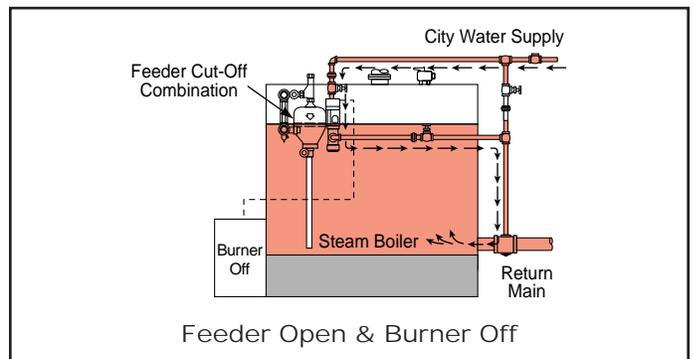
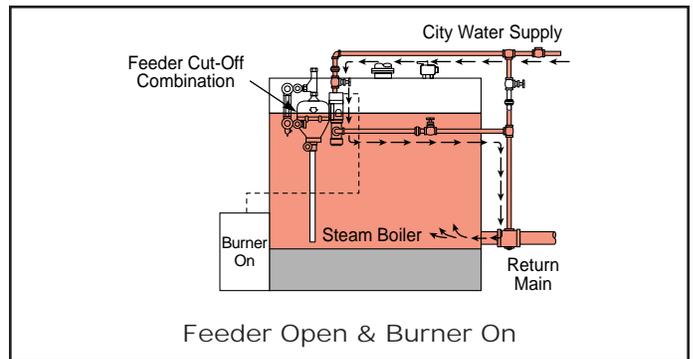
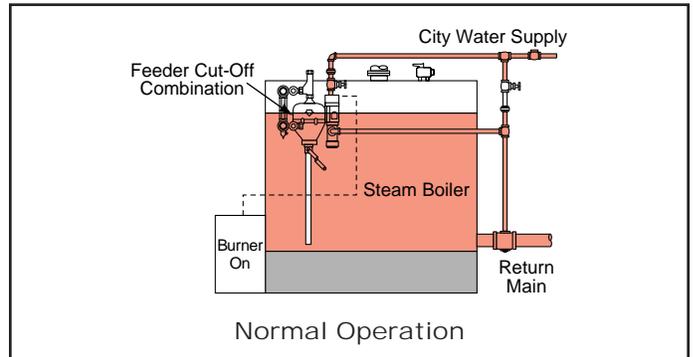
Automatic water feeders help you avoid these problems. They watch that water level, maintaining a safe *minimum*. They allow the boiler water line to rise and fall naturally through its normal operating range.

How a Feeder/Cut-Off Combination Works

During Normal Operation – This is how a McDonnell & Miller feeder/cut-off combination looks on a steam boiler. Notice how we have it installed well below the boiler’s “normal” start-up operating range (that’s about two-thirds up the gauge glass). We don’t want it to feed while the water is out in the system as steam. Remember, the automatic water feeder is there to maintain a safe minimum water line, not a “normal,” start-up water line.

As you now see it in the drawing, the feeder is closed and the burner is firing. The boiler is working, sending steam out to the building, and both the automatic water feeder and low water cut-off are standing by.

The Feeder Opens – If the boiler’s water line drops to the feeder/cut-off combination’s feeder-operating point (which is very near the bottom of the gauge glass), the



feed valve will open mechanically and add water to the boiler. How much water will enter the boiler depends on several things, but there will always be enough to keep the boiler operating at a safe *minimum* water level. Once it has added the right amount of water, the feeder closes.

While this is happening, the burner continues to run because the feeder keeps the boiler from dropping to its low water cut-off point.

The Low Water Cut-Off Stops the Burner – But suppose something happens and the automatic water feeder can't keep up with the rate at which the boiler is losing water. Suppose, for instance, that a pipe breaks or someone opens a boiler drain, causing the boiler to suddenly lose water. Should this happen, the water level will drop to a preset point, and the automatic feeder/cut-off combination will instantly cut power to the burner, shutting it down and protecting the boiler from a dry-firing condition. Though the burner is off, the automatic feeder will continue to add water to the boiler in an attempt to restore a safe minimum water level.

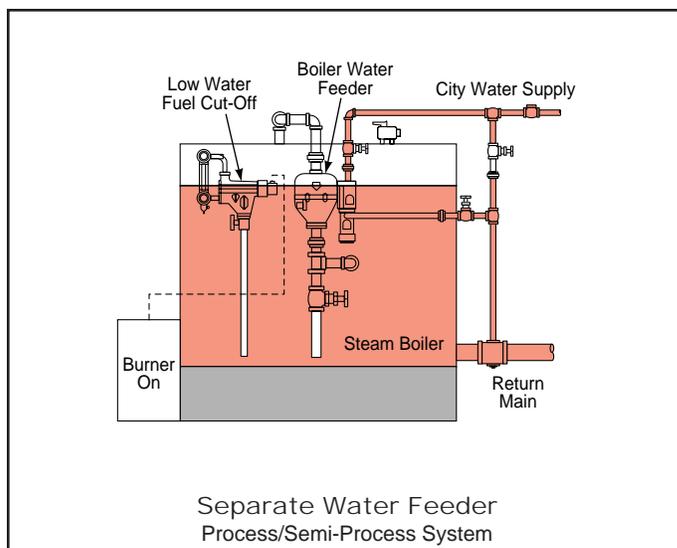
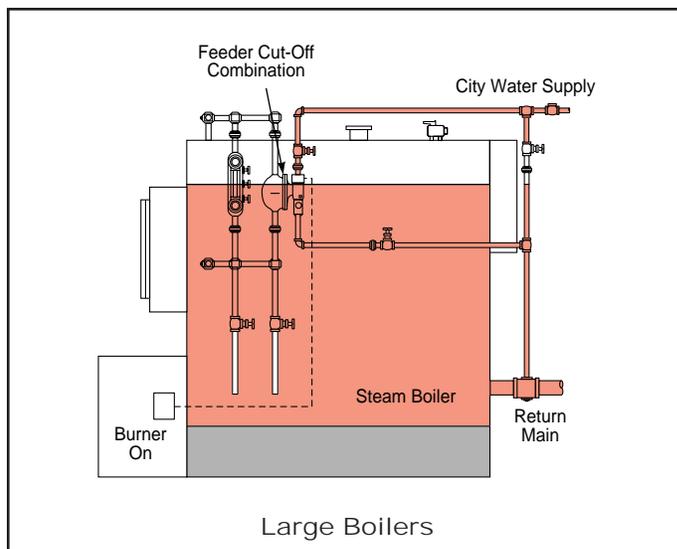
As you can see, a combination *mechanical* water feeder and *electrical* low water cut-off provides you with boiler protection even if the power fails or something goes wrong in the burner circuitry.

Combination Water Feeders and Low Water Cut-Offs for Larger Boilers

As we said earlier, all steam boilers evaporate water at the rate of one-half gpm per 1,000 square feet EDR (240,000 BTU/HR). To satisfy a larger boiler's needs, an automatic water feeder must be able to match the boiler's higher steaming rate. If the feeder can't keep up, the burner will suffer from nuisance low water shutdowns. To avoid this problem, we make automatic feeder/cut-off combinations with wider flow orifices to meet the special needs of larger boilers. The operation of these larger units is the same as the ones we just looked at. The key difference is the increased flow rate.

Once the larger feeder/cut-off combination satisfies the boiler's minimum water line needs, it has to be able to close against the force of the city water pressure moving through that extra wide orifice. This calls for considerable float and lever power, and it explains why our feeder/cut-off combinations for larger boilers are bigger than those for smaller boilers. We've carefully engineered them to get the maximum closing force in the space we have to work with. This ensures the unit will close tightly once it's done its job.

Codes call for larger boilers to have their gauge glasses mounted on water columns, rather than directly into the



boiler. Consequently, we make our larger automatic water feeders and feeder/cut-off combinations without “quick hook-up” fittings. Instead, we give these larger combinations one-inch (25mm), float chamber tappings so you can mount them directly on an equalizing line.

Watching the Water Level in Process/ Space-Heating Boilers

Now let’s suppose you’re installing a steam boiler in a factory. Some of the total steam load will travel to unit heaters where it will keep the workers warm. The rest of the steam will go to a steam table in the cafeteria, a dishwasher, an oil preheater on the boiler, a few sterilizing cabinets on the plant floor, and a half dozen other process applications.

This job offers a special challenge because a good portion of the condensate won’t be working its way back to the boiler. Some of this condensate is tainted in the process and we need to handle it specially. Because of this, you’re going to have to consistently add feed water to keep this process/space heating boiler operating.

If you use a combination feeder/cut-off on this job you may run into a problem because the vertical space on the control between its “feed” point and its “cut-off” point is relatively small. The feeder might not be able to keep up with the system’s process needs, and if it can’t, the boiler might drop into a low water condition and shutdown.

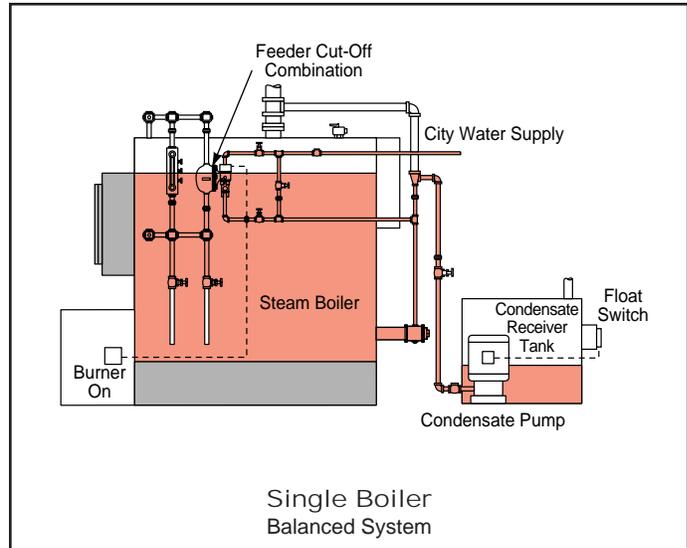
It’s best to install a *separate* automatic feeder and low water cut-off on a job such as this when you know some condensate won’t be returning. Set up this way, the feeder can open fully and deliver its maximum capacity to the boiler before the low water cut-off (installed at a lower level) goes into action. By piping the system like this, you eliminate nuisance burner cut-offs while meeting both your heating and process needs.

When you select the water feeder and low water cut-off for your process/space heating application, always check to make sure the operating pressure of your system doesn’t exceed the maximum operating pressure of either control.

The Importance of System Balance

Steam Systems With Condensate Pumps

Most two-pipe steam systems, and some one-pipe steam systems, need help returning condensate to the boiler. The pump’s job is to provide the “push” the water needs to get back into the boiler. The water leaves the boiler as steam, condenses into a liquid in the



radiators and piping, and flows by gravity into a condensate receiver. When the water level inside the receiver reaches a certain point, an electrical float switch turns the pump on. The pump quickly moves the water out of the receiver and back into the boiler.

Steam boilers served by condensate pumps also need low water protection, and our low water cut-offs serve that purpose well. You can also use an automatic water feeder or a combination feeder/cut-off on these systems. But before you do, make sure the system is well balanced. What we mean by “well balanced” is that the condensate pump should be able to return the water to the boiler before the boiler’s water level drops to a point where the low water cut-off or automatic feeder goes into action.

If the automatic water feeder adds water to the boiler (to maintain a safe minimum operating level), and *then* the condensate pump returns its water to the boiler, the boiler will most likely wind up with too much water. This excess water limits the boiler’s steam making space. Without enough room to break free of the water, the steam can carry water up into the system piping. That leads to higher fuel bills, uneven heating, water hammer, scale formation in the boiler and burner short cycling.

So before you use an automatic water feeder on a steam boiler that’s served by a condensate pump, check to see if the system is well balanced. It should run through its cycles without going off on low water. In other words, the condensate pump should balance the flow of water back into the boiler before the level drops to the critical, low water point. Keep in mind that a system with a condensate pump can become unbalanced if the returns clog with sediment or if any steam traps fail in an open position.

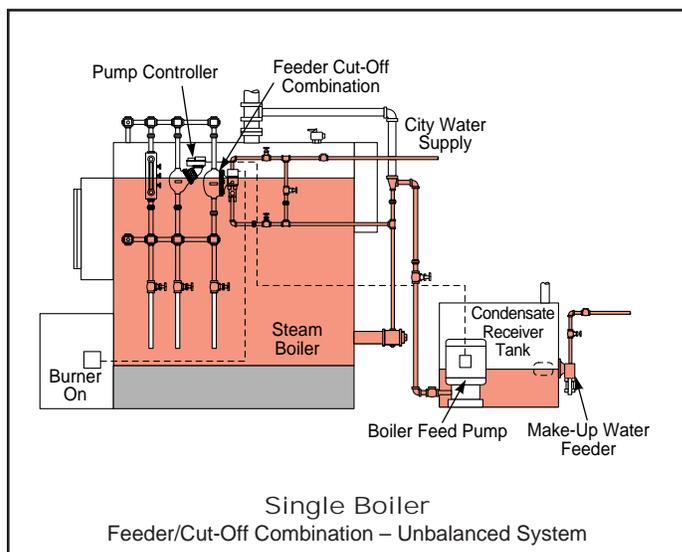
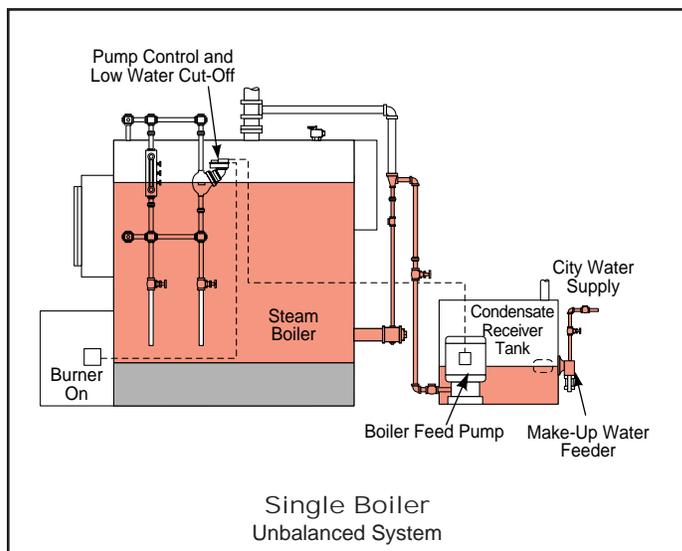
Good troubleshooters always keep their eyes wide open.

Steam Systems with Boiler-Feed Pumps

If you have a system where some steam is going for process (meaning, it won’t be coming back), or if your system isn’t well balanced, you should consider using a boiler feed pump instead of a condensate pump.

A boiler feed pump serves the same purpose as a condensate pump. It provides the “push” the water needs to get back into the boiler. The difference between a condensate pump and a boiler feed pump, however, lies in the way we control the two units. Instead of having an electrical float switch inside the condensate receiver, a boiler feed pump takes its orders from a McDonnell & Miller pump controller mounted directly on the boiler.

The pump controller has two switches. The first switch (set at the higher of the two levels) 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 gauge glass, the pump controller stops the pump.

Should the pump not be able to keep up with the boiler's need for water, the pump controller will sense this as well. The second switch (set at the lower of the two levels) will cut the electricity to the burner and protect the boiler from a low water condition.

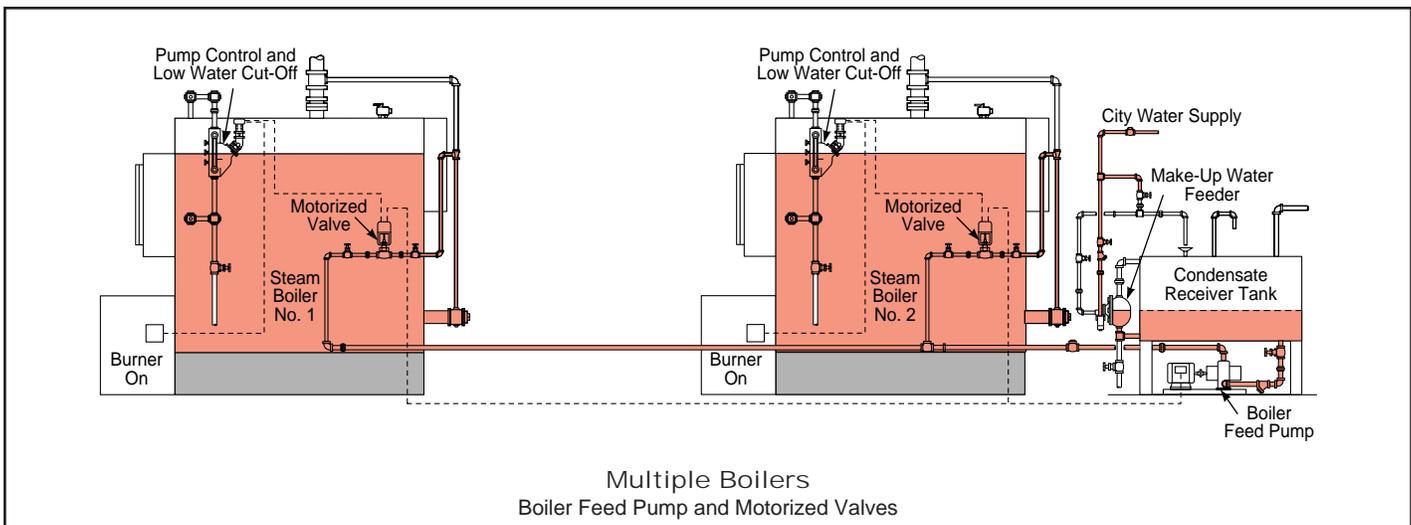
Feed water enters the system through a make-up water feeder in the boiler feed pump's receiver. If you wish, you can add a feeder/cut-off combination to operate at a level a bit lower than the pump controller. This will give you a mechanically operated feeder, which will act as a back-up should something go wrong with the pump controller. It will also give you a secondary low water cut-off. It's like having a belt *and* suspenders for your boiler!

Meeting the Needs of Systems with Multiple Steam Boilers

The boiler on the right may be a stand-by to the boiler on the left. Every week or so, a boiler attendant might switch them, making this one the operating boiler and the other the stand by.

It's a good idea, one we've used for years in larger boiler rooms. By having more than one boiler, each is able to supply the entire needs of the system. Your chances of getting caught without steam are much less.

Some systems have multiple steam boilers. The idea here is to let several boilers join forces to meet the total needs of the system. The goal is energy conservation. You steam all the boilers on start-up, and then shut a few



down after you've heated the system and satisfied the piping pick-up load. In other words, you put the system on "simmer" after you've heated it completely.

Steam systems with more than one boiler often have problems if the installer fails to realize that steam is dynamic and not static. By this, we mean that steam is always moving *very* quickly from the boiler to the system, and as it moves, it loses pressure. And since one ounce of pressure represents a water column 1¾ in. (45mm) high, the slightest difference in pressure between any two boilers interconnected on their return sides can make a big difference in the individual water levels.

A slight burr in a pipe or fitting can create a drop in pressure. You can never tune two burners to produce the same flame. One boiler will always be closer to the system take-off than another. These things speak loudly for proper piping and thoughtful management of the boiler water line so that's what we'll look at next.

Multiple Boiler Systems with a Boiler Feed Pump and Motorized Return Valves

Here we have two boilers served by a single boiler feed pump. One boiler may be a stand by to the other, or they may be sharing the total load. For piping purposes, we'd handle either application the same way.

Notice how the condensate returns are independent. Each flows from the boiler feed pump receiver to the boiler through a motorized valve. This is an important detail. If you were to interconnect the returns, the water from one boiler would flow into the other.

Steam Moves – Remember, steam is dynamic, not static. Water doesn't "seek its own" level when the steam is moving out of the boiler. The slightest difference in firing rate or piping pressure drop between the two boilers will cause one to flood and the other to shut down due to a low water condition. This is why those independent returns are important. We're using motorized valves on this installation (illustration on page 21) to isolate one boiler from the other. When either boiler needs water, the McDonnell & Miller pump controller on that boiler will drop to a point where it will close the higher of its two switches. That switch will power that boiler's motorized valve, causing it to open. When it's fully opened, the motorized valve will trip an end switch and start the boiler feed pump. Water will flow only to the boiler that needs it. The float in the pump controller will sense the rising water. When the water reaches the proper level, the pump controller will break the electrical connection to the motorized valve. The valve will begin to close, shutting off the boiler feed pump as it does.

As you can see, when we pipe multiple boilers this way it

doesn't matter how big or small each is. The boiler feed pump, although sized for the *total* needs of all the boilers, will satisfy the needs of each in turn, no matter what size.

Keeping the Water Flowing – We've installed a make-up water feeder in the boiler feed pump's receiver tank. It's job is to maintain a minimum water line in the tank so the pump will always have a reservoir from which it can draw feed water. In this system, all the water will enter the boilers through the boiler feed pump. If, for any reason, the boiler feed pump can't keep up with the boiler's rate of evaporation, the water line in the boiler will drop. The lower switch in the McDonnell & Miller pump controller will stop the burner.

If you find the pump suddenly can't keep up with the boiler's needs, check the temperature of the returning condensate. As thermostatic radiator steam traps and end of main F&T traps age and fail, they pass steam into the returns. That can make the condensate hot enough to "flash" when it hits the pump's impeller. Boiler feed pumps can't move water once it has flashed to steam. The pump will turn and cavitate, but it won't satisfy the boiler.

Ideally, in a low pressure steam heating system, the condensate in the pump's receiver shouldn't be hotter than 180°F (82°C).

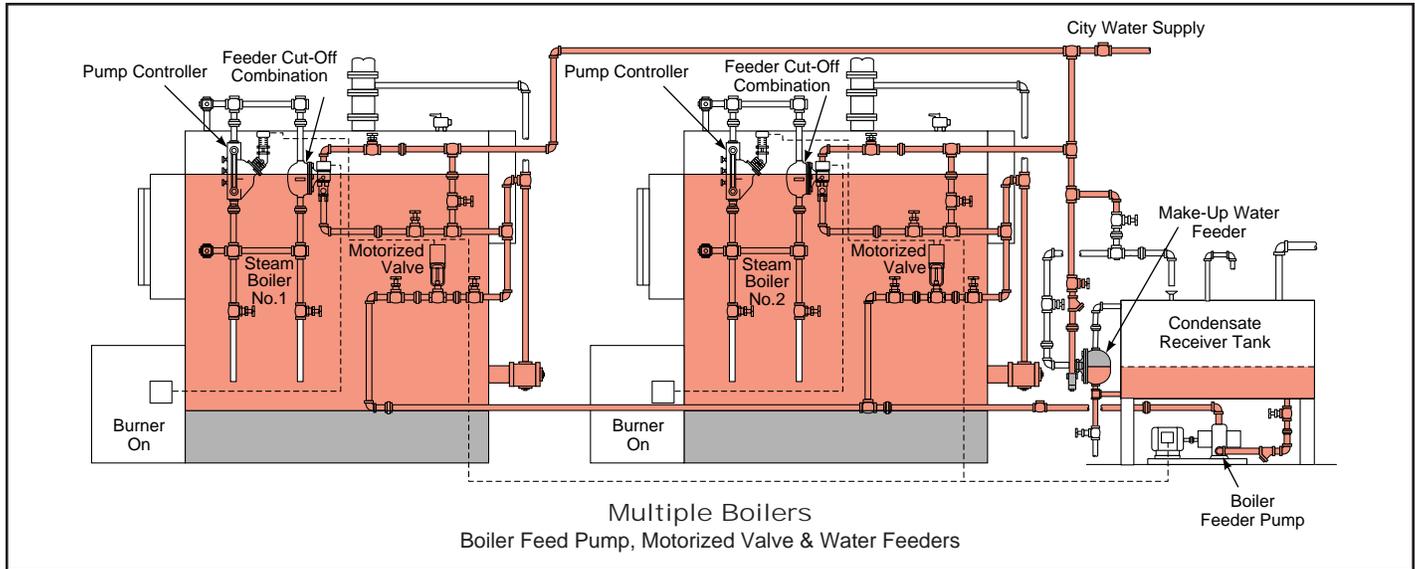
Multiple Boiler Systems with a Boiler Feed Pump, Motorized Return Valves and Boiler Water Feeders (illustration on preceding page)

This is the same system we just looked at, except we've added a combination automatic water feeder and low water cut-off to a point just below the pump controller. The feeder/cut-off's job will be to add water mechanically to the boiler should something happen to the boiler feed pump (for instance, if it's cavitating because the return condensate is too hot).

Think of the feeder/cut-off as a back-up device to keep the boiler in operation should something go wrong elsewhere. The low water cut-off will back up the pump controller's primary low water cut-off should something go wrong there, or if the feeder can't keep up with the boiler's rate of evaporation for some reason.

Multiple Boiler Systems with a Boiler Feed Pump, Motorized Return Valves and Electric Proportioning Regulator (illustration on following page)

Here we're controlling the water lines with electric proportioning regulators. We're matching the incoming feed water to the exact amount of water that's leaving as



steam. By doing this, we're able to maintain a precise water line in both boilers and take advantage of each boiler's full steaming space.

There are times when steaming loads will vary tremendously. This is especially true of steam heating systems in larger buildings. We often set up these buildings to operate on outdoor air temperature sensors and night set-back devices. When the system first starts in the morning the boilers will steam longer than they will during the day when the pipes and radiators are hot. This is also true of seasonal operation when you run the heating system less often.

This is when proportioning regulators can make a big difference. By closely monitoring the water line, regardless of varying system conditions, you improve the quality of steam leaving the boiler and allow the system to operate more efficiently.

Receiver Tank Control

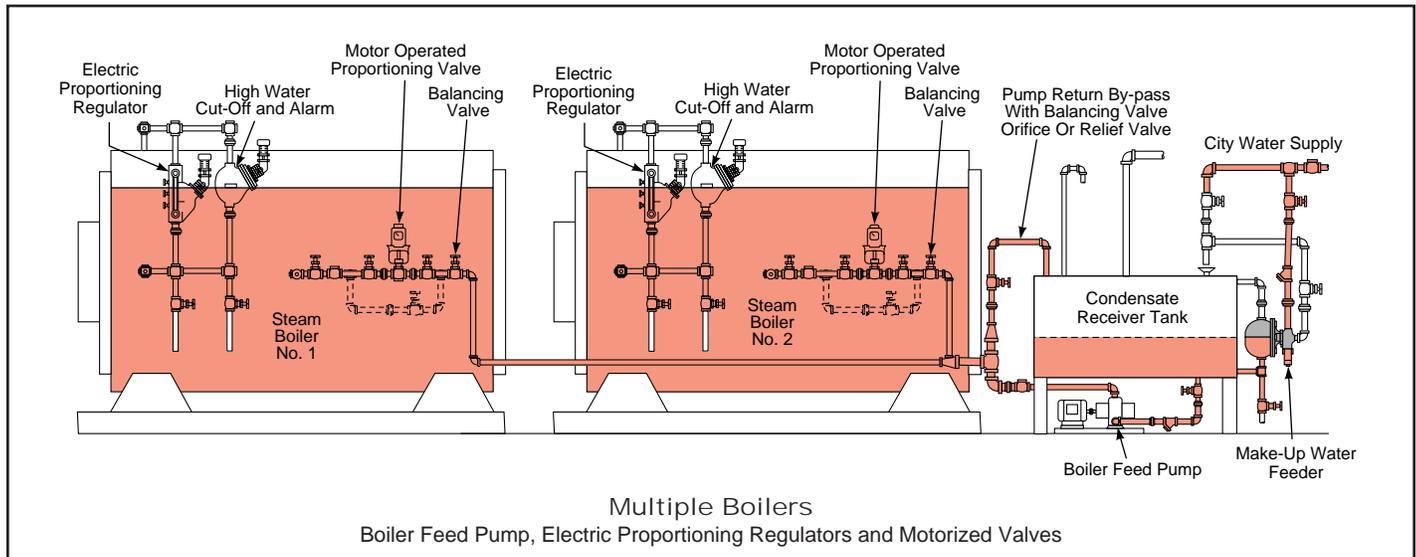
If you size a boiler feed pump's receiver properly it will be able to hold the right amount of water to keep the boiler operating during the start-up cycles. It will also be able to receive the returning condensate without overflowing.

Receiver sizing is more an art than a science. You have to look closely at the entire system to figure out how long it will take the condensate to return from the building. There are many variables to consider: The type and condition of steam traps, the pitch and cleanliness of steam mains and returns, the pipe insulation or lack of it, the shape of the building and how people use it.

There are also the times when you'll have to deal with condensate transfer pumps, or maybe a vacuum/condensate pump. These pumps collect and relay return

water back to the boiler feed pump. There are many things that can affect how quickly these secondary pumps move condensate back to the primary boiler feed pump. You have to consider them all when you're sizing a feed pump receiver.

One thing will be a constant, however. There must always be enough water in the receiver for the boiler to draw from during the start-up cycle (the time between initial steaming and the return of condensate from the



building). A McDonnell & Miller make-up feeder, set at the one-third full point on the receiver tank, will meet the boiler's needs during this crucial start-up time. Let's take a closer look at these.

Receiver Tank Make-Up Water Feeders (illustration on following page)

Here, we've mounted a McDonnell & Miller make-up water feeder on a one-inch (25mm) NPT equalizing line that extends from the top of the tank to the bottom. The level in the feeder's chamber will be the same as the level in the tank. As the pump moves water out of the tank and into the boiler, the float inside the feeder's chamber will open and constantly replenish the tank's reservoir.

We've designed our feeders with the right amount of float and lever power to close tightly against city water pressure. This ensures that there will always be enough tank space to receive the returning condensate without having it overflow.

If the tank you're using doesn't have tappings for an equalizing line, you can use our internal feeder. As you can see, it mounts directly inside the tank and feeds water through its integral strainer. We make this unit with two flange sizes for both new and retrofit installations.

A Make-Up Water Feeder Used as a Pilot Valve

When you have multiple boilers, the boiler feed pump has to be able to meet the needs of *all* the boilers should they need water simultaneously. During the start-up cycle, the draw from the feed pump's receiver can be very heavy and the make-up feeder has to be able to match that flow.

When we run into this situation, we often use a make-up water feeder as a pilot valve to operate a high capacity diaphragm valve with "dead-end" service. When the feeder opens it signals the diaphragm valve to snap into action. The larger valve quickly maintains the receiver at the one-third full point. Once the feed pump shuts off the dead-end service valve closes tightly to prevent over filling. If returned condensate fills the receiver, the feed valve, of course, stays closed. This piping arrangement also gives you a lot of freedom because you can put the diaphragm valve in a remote location, if you'd like, for easier service.

A Make-Up Water Feeder with a Motorized Valve (illustration below)

Here's another way you can quickly fill the receiver. Use a McDonnell & Miller controller to sense the tank's water line. As the level rises and falls, the controller will electrically operate a high capacity motorized valve. This is another piping arrangement that gives you a lot of freedom. You can place that motorized valve anywhere you'd like.

Low Water Cut-Offs for Receiver Tanks (illustration on following page)

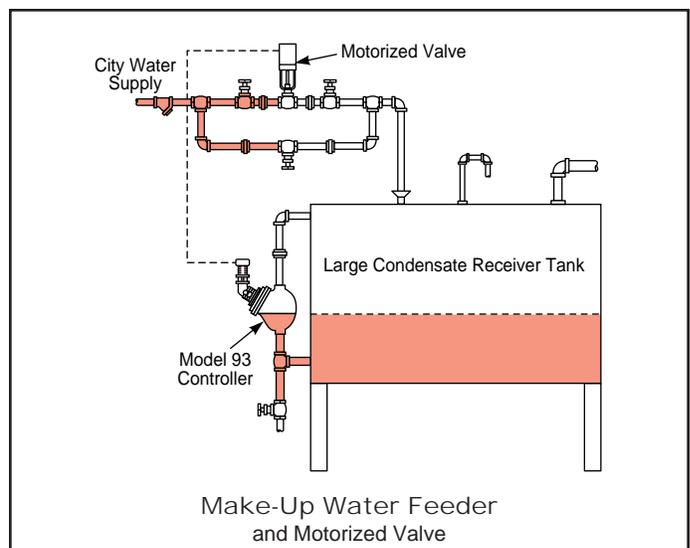
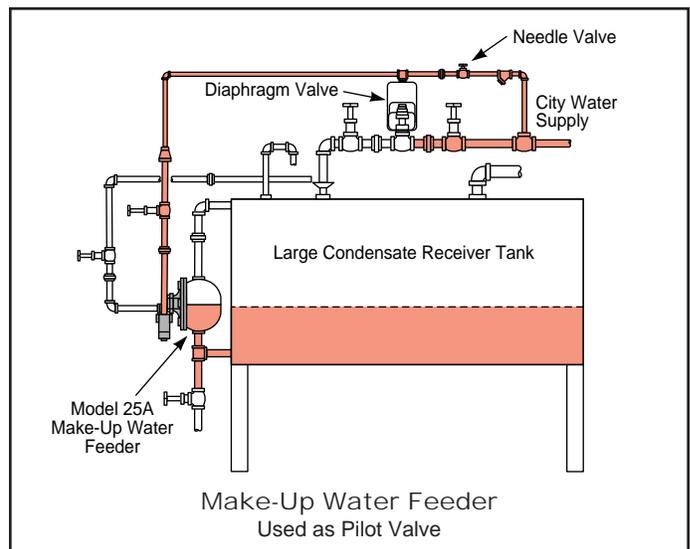
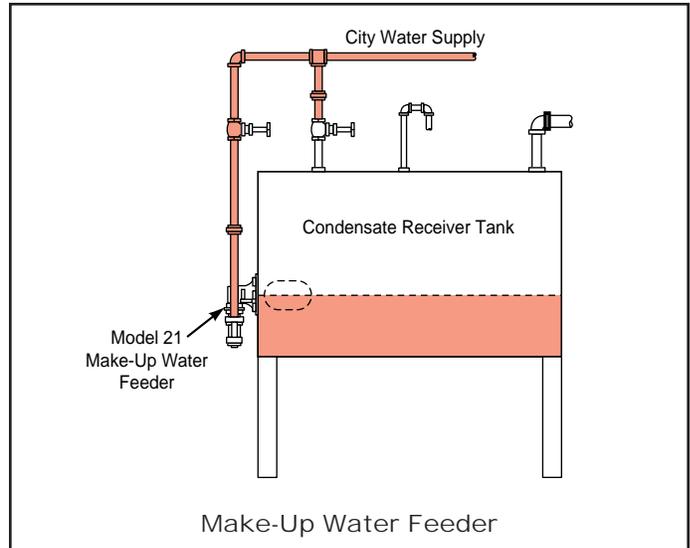
There's always the possibility for human error on any job. For instance, suppose someone decides to turn off the water supply to your receiver tank. The pump controller on the boiler will still start the pump, but once the receiver goes dry there won't be any water to pump because of the closed valve. Or suppose the building loses water pressure and the feed pump suddenly finds itself moving more water than the water feeder can replace. If the pump runs dry, it will cavitate and its mechanical seal will quickly heat and break. That leaves you with a costly repair and system down time.

If you install a low water cut-off in an equalizing line around the tank, the cut-off will protect the pump no matter what happens.

Hot Water Boilers

(illustration on following page)

Low water protection isn't just for steam boilers. Hot water boilers face the same perils of overheating damage if the water line drops too low. Many people



don't think of this as often as they should because hot water boilers serve "closed" systems. They have pressure reducing valves that are supposed to feed water automatically should a leak develop.

The truth, however, is that a pressure reducing valve is no substitute for a low water cut-off. Pressure reducing, or "feed" valves, often clog with sediment and wind up not feeding at all. A buried pipe can corrode and spring a leak that flows faster than a "feed" valve can satisfy. Relief valves can pop and, while dumping water at a great rate, actually prevent the feed valve from operating.

Let's take a closer look at how we can protect these boilers.

Hot Water Systems

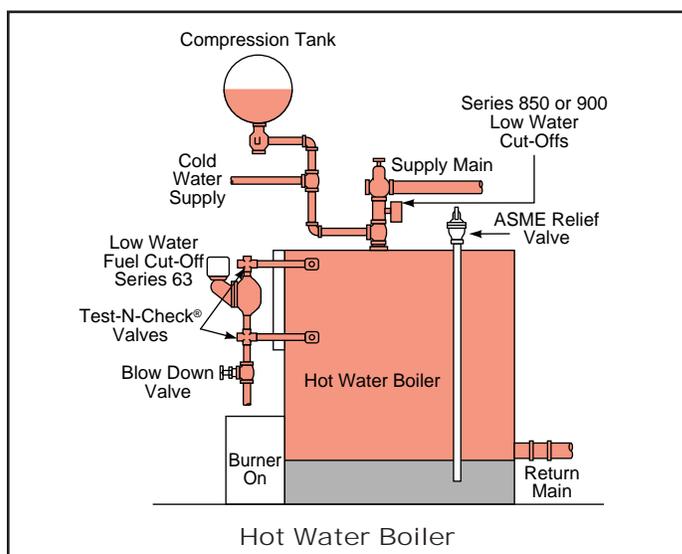
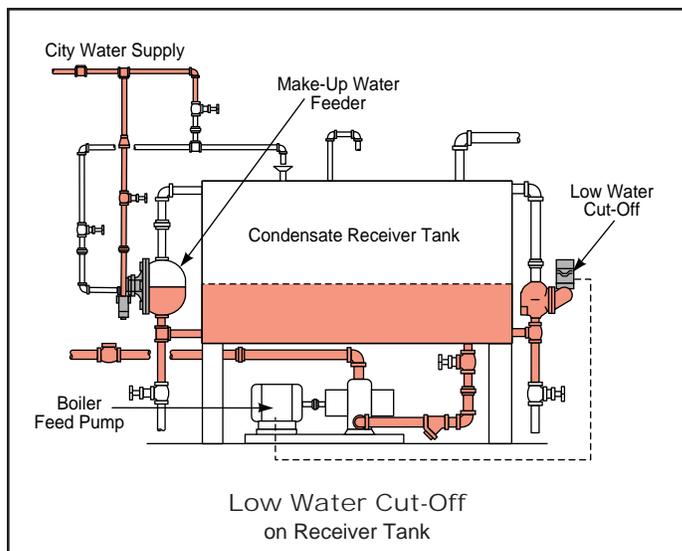
As we said, the things that affect steam boilers also affect hot water boilers. If you run them with too much water the relief valve will open. If you run them with too little water they'll overheat and suffer damage.

A low water cut-off is the only sure way of protecting a hot water boiler from sudden loss of water. The ASME boiler code recognizes this by requiring all hot water boilers of 400,000 BTU/HR or more input to have low water fuel cut-off devices.

ASME doesn't call for low water cut-offs on smaller, residential boilers, but we think *all* hot water boilers, regardless of their size, must have protection. However, the International Mechanical Code requires low water cut-offs on **ALL** hot water and steam boilers. ITT McDonnell & Miller make several devices, both float and probe type, that protect and meet the needs of any boiler whether it's cast iron, steel, or copper construction.

Hot water systems regularly lose water through faulty air vents, loose valve stem packing, cracked boiler sections, loose nipples, corroded pipes, broken or loose pump seals, leaking gaskets, dripping relief valves, to name just a few places. Most installers depend on their pressure reducing or feed valve, to replace the lost water automatically. But feed valves often clog with sediment, especially in hard water areas. And it's very easy to close the supply valve to a feed valve and forget to open it again.

On systems with buried pipes (say, a radiant heating system) a feed valve will open if a pipe breaks. It will feed fresh water continuously until it either clogs (and stops feeding) or destroys the ferrous components of the system with oxygen corrosion. A simple feed valve can wind up costing a lot more than its purchase price. This is why major suppliers of feed valves, such as ITT Bell & Gossett, recommend you close the feed valve once you've established your initial fill pressure.



This is also why we strongly recommend you use a low water cut-off on every hot water boiler. Feed valves are not a substitute for low water cut-offs. They can't protect your boilers from a low water condition. Feed valves are fine for filling the system initially, and for helping you vent air from the radiators. But once the system is up and running, you shouldn't look to them for protection.

Over firing

There are times when hot water boilers don't lock-out on safety. Whether by control failure or human error, things go wrong. And when they go wrong in a hot water heating system, the water temperature can rise quickly to a point where the expansion tank can't take up the expansion of the water. This causes the relief valve to discharge.

When the relief valve opens, there's a sudden drop in system pressure. The water, which at this point is probably much hotter than 212°F (100°C), will flash into steam. This is why ASME insists that relief valves for hot water boilers carry steam-discharge ratings.

If a feed valve doesn't open to replace this rapidly exiting water, a low water condition will quickly result. The only thing that can protect the boiler at this point is a low water cut-off. The feed valve can't protect the boiler because its typical setting is 12 psig (.83 bar). In other words, the system pressure must drop below 12 psig (.83 bar) before the feed valve will open.

The trouble is that while the relief valve is open and flashing steam to atmosphere, the internal system pressure never drops anywhere near 12 psig (.83 bar). A relief valve with a 30 psig (2.1 bar) setting, for instance, will open at 30 psig (2.1 bar), and close again when the pressure drops to about 26 psig (1.79 bar). The result is a loss of water with no make-up. Repeat this cycle enough times and the boiler will be in a dangerous, low water condition. Keep in mind, steam exerts pressure. It can easily fool a feed valve, and that's why feed valves offer very little protection at all against low water.

Feeder/Cut-Off Combinations for Cast Iron and Steel Hot Water Boilers

To protect a boiler from dry firing, the low water cut-off must be located above the boiler's crown. After the low water cut-off shuts off the burner, you should have a way to add water to the system to ensure the crown stays under water.

A combination water feeder and low water cut-off can do this for you. If you position the feeder above the boiler's crown, it will mechanically feed water if the level should



drop to that point. This is an important consideration because, even if the electricity is cut off, it's possible for the firing cycle to continue if the fuel feed valve is mechanically locked open. The combination unit's cut-off switch will act as a back-up to the primary low water cut-off, providing the boiler with additional protection.

Protecting Copper Fin Tube Boilers

Copper fin tube boilers move heat from the flame to the water almost instantly. This type of boiler depends on the proper flow of water across its heat exchanger to move the heat quickly out of the boiler and into the system. Should flow stop while the burner is operating, heat will quickly build and cause the water in the heat exchanger to flash into steam. This condition is similar to a dry firing in a cast iron or steel boiler.

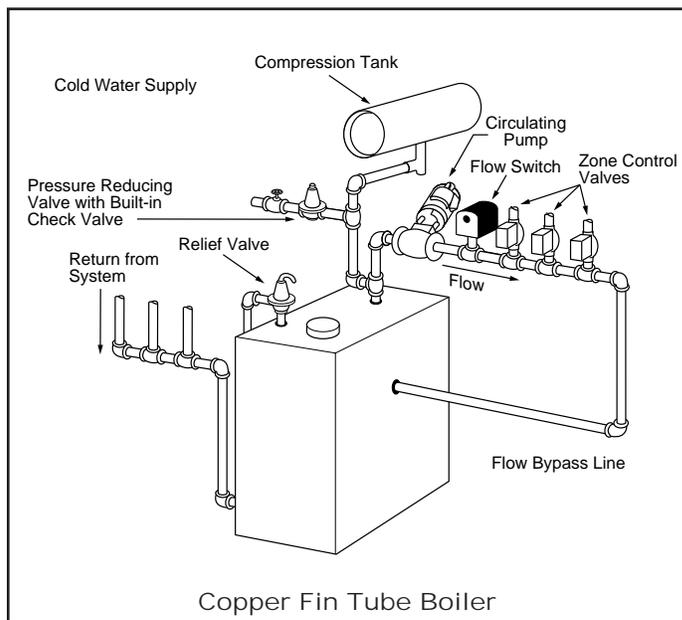
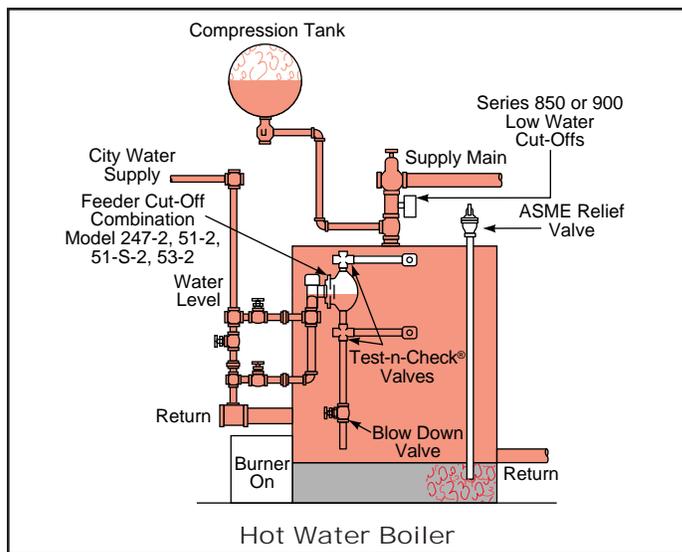
A McDonnell & Miller flow switch, installed on the copper fin tube boiler's hot water outlet, protects it from this danger. The burner cannot fire unless water is moving across the flow switch. When the flow stops, for whatever reason, the McDonnell & Miller flow switch immediately cuts electrical power to the burner and protects the boiler from overheating.

Pressure Relief Valves

Good engineering practice calls for every hot water boiler to have a pressure relief valve. This spring-loaded valve must be able to release the boiler's entire load at the boiler's maximum operating pressure.

Here are some things that can cause a relief valve to open in a hot water heating system:

- The automatic feed valve fails, allowing higher than normal pressure to enter the system.
- Someone leaves a hand bypass line open after filling the system.
- Someone hydrostatically tests the system at a pressure greater than the relief valve's setting.
- The air cushion in the diaphragm type compression tank doesn't match the system's static fill pressure. Keep in mind, most tanks come from the factory precharged at 12 psig (.83 bar). If the system needs more than 12 psig (.83 bar) pressure, you have to add more air to the tank, and you have to do this while you have the tank disconnected from the system.
- The compression tank may be too small for the system.
- The boiler's aquastat is in a well without heat transfer grease. When this happens, the boiler's temperature will quickly exceed the aquastat's setting, causing rapid rise in system pressure.



- The circulator may be on the return side of the system with the compression tank at its suction. If it is, the circulator's head pressure will appear inside the boiler as a net increase. It may be enough to open the relief valve.
- The burner limit may be jumped-out or stuck in a manual position.

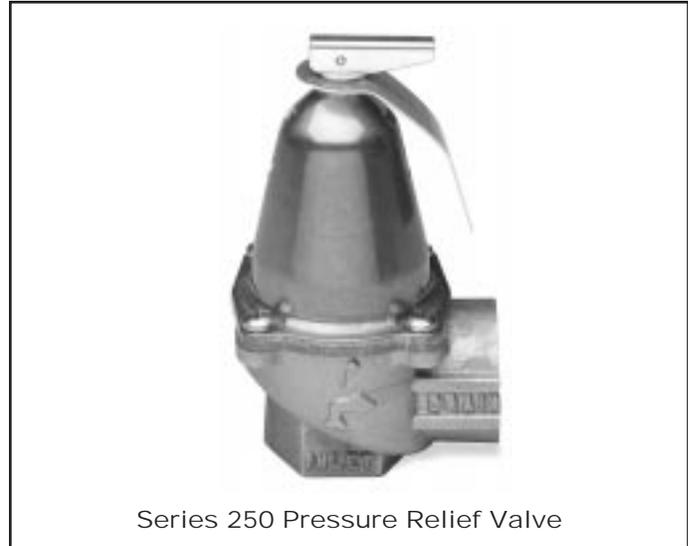
The main thing to keep in mind when you're troubleshooting this one is that relief valves pop when any of these three things happen:

- The compression tank loses it's air cushion
- The system takes on more water.
- The system temperature increases.

Think methodically, and keep your eyes wide open!

We hope this Basic System Operation Guide has given you insight into the systems on which you're now working or will face in the future. We welcome any questions or comments you may have about the Guide, or about our products.

Thanks for your support, and for your continuing business.



Hot Water Boilers

McDonnell & Miller Low Water cut-offs are specially designed to protect hot water boilers from the hazards of a low water condition. In operation they will interrupt the electrical current to the firing device, if the water in the system drops below the boiler manufacturer’s minimum safe water level.

Our low water cut-offs also provide an additional circuit for a low water alarm, should you desire to install one, for additional protection.

How to Select Low Water Cut-Offs for Hot Water Boilers

Boiler pressure and the method of mounting are the primary factors to consider when selecting a low water cut-off.

Maximum Boiler Pressure psi (kg/cm ²)	Method of Installation		Product Series	Size NPT in. (mm)	Blow Down Valve	
	Directly into Boiler Tappings OR on the Boiler Supply Riser*	To Piping Above the Boiler with 1" (25mm) Equalizing Piping			Required	Provided with Low Water Cut-Off
50 (3.5)	X		RB-24	3/4 (20)	No	N/A
		X	63	1 (25)	Yes	No
		X	64	1 (25)	Yes	No
	X		64-A	1/2 (15)	Yes	Yes
	X		764	2 1/2 (65)	Yes	No
160 (11)	X		850	3/4 (20)	No	N/A
	X		RB-120	3/4 (20)	No	N/A
160 - 250 (11-18)	X		750	3/4 - 1 (20 -25)	No	N/A

* Use the tapping designated by the boiler manufacturer for low water cut-off installation.

Low Water Cut-Offs – Electronic For Hot Water Boilers

NEW

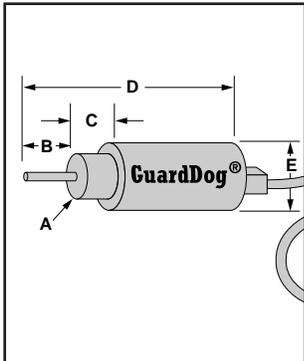
Series RB-24 c

Low Water Cut-Offs

- For residential applications
- Automatic reset feature resumes operation after a power outage
- LED for power to the unit and the presence of water in the boiler
- No blow down required
- Maximum ambient temperature 120°F (49°C)
- Voltage across probe to ground
- Probe sensitivity 15,000 ohms at 120 VAC
- Maximum power consumption 2.5 VA
- Maximum water temperature 250°F (121°C)
- Maximum water pressure 160 psi (11.2 kg/cm²)



Model RB-24



Electrical Ratings

Voltage	Power	Load Switching
24 VAC	2 VA	2 A at 24 VAC

Dimensions, in. (mm)

A	B	C	D	E
$\frac{3}{4}$ (20) NPT	$\frac{3}{4}$ (19)	$\frac{3}{4}$ (19)	3 (76)	$1\frac{3}{4}$ (19)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
RB-24	144685	Residential low water cut-off for gas fired boilers	.7 (.32)

BOILER CONTROLS

Low Water Cut-Offs – Electronic For Hot Water Boilers

Series 750
Low Water Cut-Offs with Remote Sensor

- For commercial and industrial applications
- Electronic circuitry with remote conductance probe level sensing
- LED low water indicator light
- Optional manual reset and test switches available
- No lock out with loss of power (if probe is in water)
- Probe lengths 4½ - 36" (11.4 - 91.4cm)
- Model 750-MT-120 meets ASME Code CSD-1 requirements
- Maximum ambient temperature 120°F (49°C)
- Voltage across probe to ground 14 VAC
- Maximum water temperature
 250°F (121°C) Model RS-1-LP
 406°F (208°C) Model RS-1-BR-1
- Maximum water pressure
 160 psi (11.2 kg/cm²) Model RS-1-LP
 250 psi (17.6 kg/cm²) Model RS-1-BR-1

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.5	43.2	125 VA at 120 or 240 VAC 50 or 60 Hz
240 VAC	3.75	21.6	

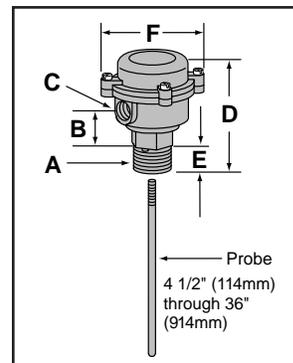
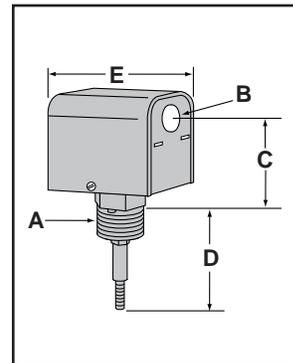
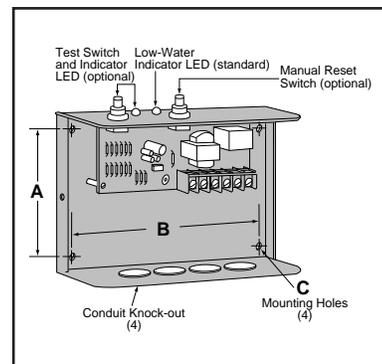
Ordering Information

(Remote sensor must be ordered separately)

Model Number	Part Number	Description	Weight lbs. (kg)
750-120	176204	Control w/auto reset	2 (.9)
750-M-120	176205	Control w/manual reset	2 (.9)
750-T-120	176206	Control w/auto reset & test switch	2 (.9)
750-MT-120	176207	Control w/manual reset & test switch	2 (.9)
RS-1-LP	176203	Remote sensor	3 (1.4)
RS-1-BR-1	179524	Remote sensor	3 (1.4)
P-1/3-SS	176208	4½" (11.4cm) probe for RS-1-BR-1 sensor	1 (0.5)
P-1-SS	179530	12" (30.5cm) probe for RS-1-BR-1 sensor	1 (0.5)
G-2-SS	179156	24" (61cm) probe for RS-1-BR-1 sensor	1 (0.5)
G-3-SS	179157	36" (90cm) probe for RS-1-BR-1 sensor	1 (0.5)

Dimensions, in. (mm)

Series	A	B	C	D	E	F
750 control unit	4¾ (106)	5½ (140)	¾ (4.8)	— —	—	
RS-1-LP remote sensor (probe included)	¾ (20) NPT	7/8 (22)	3 (80)	2¾ (70)	3¾ (86)	—
RS-1-BR-1 remote sensor	1 (25) NPT	1¹¹/₆ (43)	½ (15) NPT	5 (127)	1¼ (32)	3¼ (83)



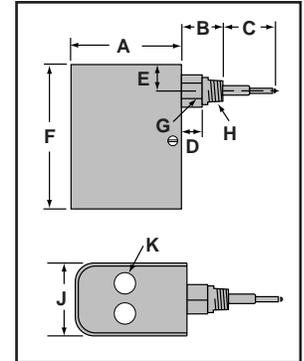
BOILER CONTROLS

Low Water Cut-Offs – Electronic For Hot Water Boilers (continued)

Series PS-850 Low Water Cut-Offs



- For residential, commercial, and industrial applications
- Electronic operation
- LED low water indicator light
- Test switch and LED indicator light
- Optional manual reset switch available
- No lock out with loss of power (if probe is in water)
- No blow down required
- No moving parts
- Maximum ambient temperature 120°F (49°C)
- Voltage across probe to ground 14 VAC
- Probe sensitivity 3,500 ohms at 120 or 24 VAC supply
- Power consumption 3 VA
- Meets ANSI specification Z21.13a – Model PS-852
- Maximum water temperature 250°F (121°C)
- Maximum water pressure 160 psi (11.2 kg/cm²)



Electrical Ratings

Model	Voltage	Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
24 VAC	24 VAC	—	—	50 VA at 24 VAC
120 VAC	120 VAC	7.5	43.2	125 VA at 120 or 240 VAC 50 or 60 Hz
	240 VAC	3.75	21.6	

Dimensions, in. (mm)

A	B	C	D	E	F	G	H NPT	J	K
4 ¹ / ₄ (108)	1 ⁹ / ₁₆ (40)	1 ⁵ / ₈ (41)	3 ³ / ₄ (19)	1 ³ / ₁₆ (21)	5 ¹³ / ₁₆ (148)	1 ³ / ₈ (35)	3 ³ / ₄ (20)	2 ⁷ / ₈ (73)	7 ¹ / ₈ (22)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
PS-851-120	153895	Low water cut-off 120V	2.7 (1.2)
PS-851-M-120	153896	PS-851-120 w/manual reset	2.7 (1.2)
PS-852-24	153919	Low water cut-off 24V	2.7 (1.2)
PS-852-M-24	153918	PS-852-24 w/manual reset	2.7 (1.2)



CAUTION

Do not use “manual reset” models with automatic water feeders. Failure to follow this caution can cause flooding and property damage.

Low Water Cut-Offs – Probe Type For Hot Water Boilers

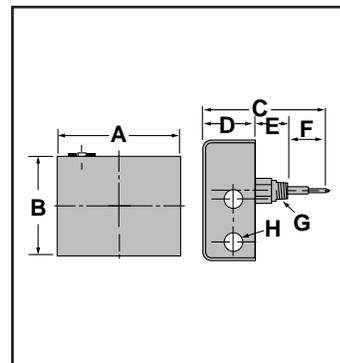
NEW

Series RB-120

- For residential and (where codes allow) commercial applications
- Electro-mechanical operation
- Automatic reset
- No blow down required
- Maximum ambient temperature 120°F (49°C)
- Voltage across probe to ground 125 VAC
- Probe sensitivity 6,000 ohms at 120 VAC supply
- Maximum power consumption 15 VA
- Maximum water temperature 250°F (121°C)
- Maximum water pressure 160 psi (11.2 kg/cm²)



Series RB-120



BOILER CONTROLS

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	5.8	34.8	125 VA at 120 or 240 VAC
240 VAC	2.9	17.4	

Dimensions, in. (mm)

A	B	C	D	E	F	G NPT	H
6 ³ / ₈ (162)	5 ¹ / ₈ (130)	6 ¹ / ₄ (159)	2 ⁹ / ₁₆ (65)	2 (51)	1 ⁵ / ₈ (41)	³ / ₄ (20)	⁷ / ₈ (22)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
RB-120	144675	Low water cut-off	3.8 (1.7)

Low Water Cut-Offs – Float Type For Hot Water Boilers

Series 63

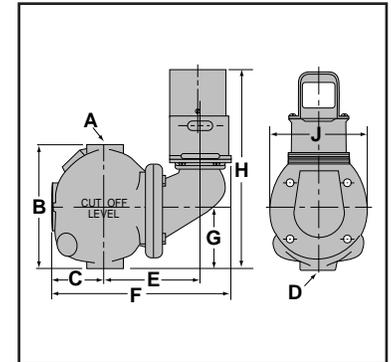


Low Water Cut-Offs

- For residential, commercial, and industrial applications
- Heavy duty
- Includes No. 2 switch
- Optional manual reset available
- Maximum boiler pressure 50 psi (3.5 kg/cm²)



Series 63



BOILER CONTROLS

Electrical Ratings

Voltage	Motor Switch Rating (Amperes) 120 VDC .5 Amp		Pilot Duty 125 VA at 120 or 240 VAC 60 Hz
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	
240 VAC	5.1	30.6	

Dimensions, in. (mm)

A NPT	B	C	D NPT	E	F	G	H	J
1 (25)	6 ¹ / ₂ (165)	2 ⁹ / ₁₆ (65)	1 (25)	5 ⁵ / ₃₂ (131)	9 ³ / ₈ (238)	3 ¹ / ₈ (79)	10 ¹ / ₂ (267)	5 ¹ / ₈ (130)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
63	142400	Low water cut-off	13.5 (6.1)
63-B	142700	63 w/ float block	15.0 (6.8)
63-BM	143300	63 w/float block & manual reset	15.0 (6.8)
63-E	142500	63 w/BSPT threads	14.0 (6.4)
63-EM	142800	63-E w/manual reset	14.0 (6.4)
63-EP	142850	63-E w/1" (25mm) NPT plug	14.0 (6.4)
63-M	143100	63 w/manual reset	14.0 (6.4)
E-28	142900	63 w/DPDT switch	14.3 (6.5)

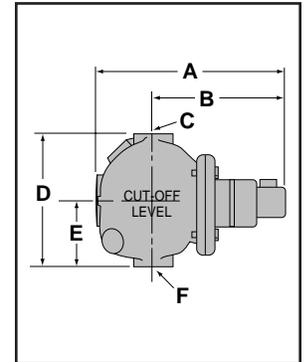
Low Water Cut-Offs – Float Type For Hot Water Boilers

Series 64



Low Water Cut-Offs

- For residential, commercial, and industrial boiler applications of any steaming capacity
- Heavy Duty
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Packless bellows
- Optional manual reset available
- 1" (25mm) NPT equalizing pipes required
- Maximum boiler pressure 50 psi (3.5 kg/cm²)



Dimensions, in. (mm)

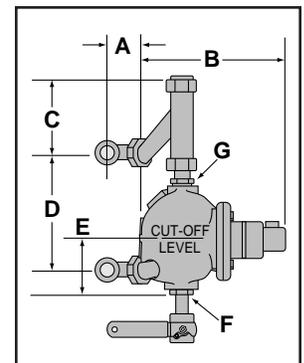
A	B	C NPT	D	E	F NPT
9 ¹⁵ / ₁₆ (252)	7 ⁷ / ₁₆ (65)	1 (25)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	1 (25)

Model 64-A



Low Water Cut-Offs

- Quick hook-up fittings provided for installation directly into gauge glass tappings



Dimensions, in. (mm)

A	B	C	D		E	F NPT	G NPT
			min.	max.			
2 ⁵ / ₈ (66)	9 ¹⁵ / ₁₆ (252)	4 ¹ / ₂ (113)	6 ⁷ / ₈ (172)	13 ³ / ₈ (339)	3 ¹ / ₈ (79)	1 (25)	1 (25)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
64	143600	Low water cut-off	11.3 (5.1)
64-A	143700	64 w/quick hook-up fittings	18.3 (8.3)
64-B	143800	64 w/float block	11.5 (5.2)
64-M	144250	64 w/manual reset	12.5 (5.7)

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

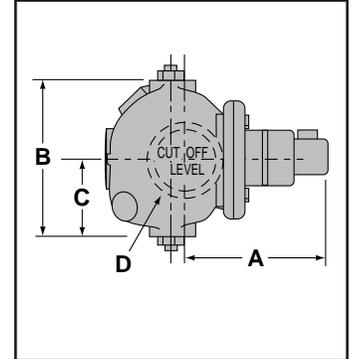
Low Water Cut-Offs – Float Type For Hot Water Boilers (continued)

Series 764



Low Water Cut-Offs

- For residential, commercial, and industrial boiler applications of any steaming capacity
- Heavy duty
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Packless bellows
- 2½" (65mm) NPT side tapping provided for installation with close nipple
- Maximum boiler pressure 50 psi (3.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D NPT
6 ⁷ / ₈ (175)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	2 ¹ / ₂ (65)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
764	144500	Low water cut-off	12.5 (5.7)

Steam Boilers

McDonnell & Miller Low Water Cut-offs are specially designed to protect steam boilers from the hazards of a low water condition. In operation they will interrupt the electrical current to the firing device, if the water in the system drops below the boiler manufacturers' minimum safe water level.

Our low water cut-offs also provide an additional circuit for a water feeder or a low water alarm, should you desire to install one, for additional protection.

How to Select Low Water Cut-Offs for Steam Boilers

Boiler pressure and the method of installation are the primary factors to consider when selecting a low water cut-off.

Maximum Boiler Pressure psi (kg/cm ²)	Method of Installation		Product Series	Size NPT in. (mm)	Blow Down Valve	
	Directly into Boiler Tappings*	Connect to the Boiler with 1" (25mm) Equalizing Piping			Required	Provided with Low Water Cut-Off
15 (1)	X		PS-800	³ / ₄ (20)	No	N/A
20 (1.4)		X	61	1 (25)	Yes	No
	X		67	¹ / ₂ (15)	Yes	Yes
	X		767	2 ¹ / ₂ (65)	Yes	Yes
	X		69	2 ¹ / ₂ (65)	No	N/A
	X		70	2 ¹ / ₂ (65)	Yes	No
	X		70-B	2 ¹ / ₂ (65)	Yes	Yes
50 (3.5)		X	63	1 (25)	Yes	No
		X	64	1 (25)	Yes	No
	X		64-A	¹ / ₂ (15)	Yes	Yes
	X		764	2 ¹ / ₂ (65)	Yes	No
150 (10.5)		X	93/193	1 (25)	Yes	No
		X	150/150S	1 (25)	Yes	No
		X	157/157S	1 (25)	Yes	No
250		X	94/194	1 (25)	Yes	No

* Use the tapping designated by the boiler manufacturer for low water cut-off installation.

Low Water Cut-Offs – Electronic For Steam Boilers

Series 750
Low Water Cut-Offs with Remote Sensor

- For commercial and industrial applications
- For **SECONDARY** low water protection
- Electronic circuitry with remote conductance probe level sensing
- LED low water indicator light
- Optional manual reset and test switches available
- No lock out with loss of power (if probe is in water)
- Probe lengths 4½" - 36" (11.4 - 91.4cm)
- Model 750-MT-120 meets ASME Code CSD-1 requirements
- Maximum ambient temperature 120°F (49°C)
- Voltage across probe to ground 14 VAC
- Maximum water temperature
 250°F (121°C) Model RS-1-LP
 406°F (208°C) Model RS-1-BR-1
- Maximum steam pressure
 15 psi (11.2 kg/cm²) Model RS-1-LP
 250 psi (17.6 kg/cm²) Model RS-1-BR-1

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.5	43.2	125 VA at 120 or 240 VAC 50 or 60 Hz
240 VAC	3.75	21.6	

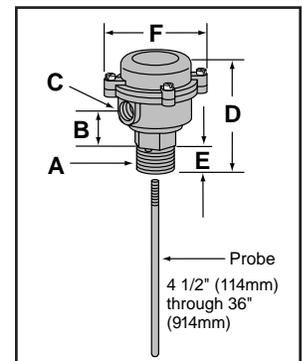
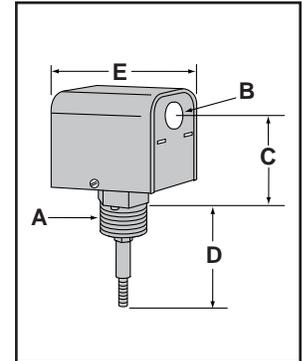
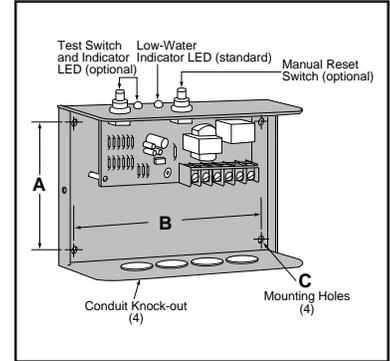
Ordering Information

(Remote sensor must be ordered separately)

Model Number	Part Number	Description	Weight lbs. (kg)
750-120	176204	Control w/auto reset	2 (.9)
750-M-120	176205	Control w/manual reset	2 (.9)
750-T-120	176206	Control w/auto reset & test switch	2 (.9)
750-MT-120	176207	Control w/manual reset & test switch	2 (.9)
RS-1-LP	176203	Remote sensor	3 (1.4)
RS-1-BR-1	179524	Remote sensor	3 (1.4)
P-1/3-SS	176208	4½" (11.4cm) probe for RS-1-BR-1 sensor	1 (0.5)
P-1-SS	179530	12" (30.5cm) probe for RS-1-BR-1 sensor	1 (0.5)
G-2-SS	179156	24" (61cm) probe for RS-1-BR-1 sensor	1 (0.5)
G-3-SS	179157	36" (90cm) probe for RS-1-BR-1 sensor	1 (0.5)

Dimensions, in. (mm)

Series	A	B	C	D	E	F
750 control unit	4¾ (106)	5½ (140)	¾ (4.8)	—	—	—
RS-1-LP remote sensor (probe included)	¾ (20) NPT	⅞ (22)	3 (80)	2¾ (70)	3⅞ (86)	—
RS-1-BR-1 remote sensor	1 (25) NPT	1⅞ (43)	½ (15) NPT	5 (127)	1¼ (32)	3¼ (83)

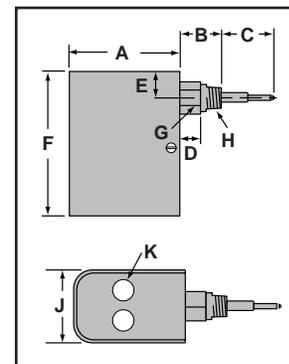


Low Water Cut-Offs – Electronic For Steam Boilers

Series PS-800 Low Water Cut-Offs



- For residential and commercial applications
- Electronic operation
- Delay on Make (DOM) feature (15 seconds)
- Delay on Break (DOB) feature (10 seconds)
- LED low water indicator light
- Test switch and LED indicator light
- Optional manual reset switch available
- Optional remote sensor available – Model PS-801-RX2
- Meets ANSI specification Z21.13a – Model PS-802
- No lock out with loss of power (if probe is in water)
- No blow down of control required when mounted directly into boiler tapings
- No moving parts
- Maximum ambient temperature 120°F (49°C)
- Voltage across probe to ground 14 VAC
- Probe sensitivity 3,500 ohms
- Power consumption 3 VA
- Maximum water temperature 250°F (121°C)
- Maximum steam pressure 15 psi (1 kg/cm²)



BOILER CONTROLS

Electrical Ratings

Model	Voltage	Motor Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
24 VAC	24 VAC	—	—	50 VA at 24 VAC
120 VAC	120 VAC	7.5	43.2	125 VA at 120 or 240 VAC 50 or 60 Hz
	240 VAC	3.75	21.6	

Dimensions, in. (mm)

A	B	C	D	E	F	G	H NPT		J	K
							Model PS-802-RX2-24	All other Models		
4 1/4 (108)	1 9/16 (40)	2 1/8 (54)	3/4 (19)	1 3/16 (21)	5 13/16 (148)	1 3/8 (35)	1/2 (25)	3/4 (20)	2 7/8 (73)	7/8 (22)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
PS-801-120	153875	Low water cut-off 120V	2.7 (1.2)
PS-801-M-120	153880	PS-801-120 w/manual reset	2.7 (1.2)
PS-801-U-120	153876	PS-801-120 w/ext. barrel	2.7 (1.2)
PS-802-24	153917	Low water cut-off 24V	2.7 (1.2)
PS-802-M-24	153913	PS-802-24 w/manual reset	2.7 (1.2)
PS-802-U-24	153916	PS-802-24 w/ext. barrel	2.7 (1.2)
PS-802-RX2-24	153914	PS-802-24 w/remote sensor	2.7 (1.2)

⚠ CAUTION

Do not use “manual reset” models with electric automatic water feeders. Failure to follow this caution can cause flooding and property damage.

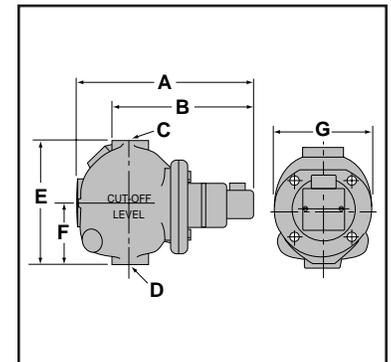
Low Water Cut-Offs – Float Type For Steam Boilers

Series 61

Low Water Cut-Offs



- For residential and commercial low pressure steam boiler applications
- For boilers of any steaming capacity
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Packless bellows
- 1" (25mm) NPT equalizing pipes and blow down valve required
- Maximum steam pressure 20 psi (1.4 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes) 120 VDC .3 Amp, 240 VDC .15 Amp		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C NPT	D NPT	E	F	G
9 ¹⁵ / ₁₆ (252)	7 ⁷ / ₁₆ (189)	1 (25)	1 (25)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	5 ¹ / ₈ (130)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
61	140100	Low water cut-off	13.5 (6.1)
61-J	140200	61 w/BSPT threads	15.0 (6.8)

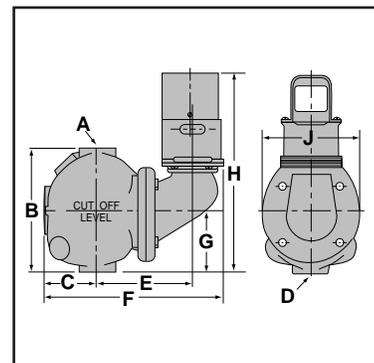
Low Water Cut-Offs – Float Type For Steam Boilers (continued)

Series 63



Low Water Cut-Offs

- For residential and commercial low and high pressure steam boiler applications
- For boilers of any steaming capacity
- Heavy Duty
- Packless bellows
- Optional manual reset available
- Maximum boiler pressure 50 psi (3.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes) 120 VDC .5 Amp		Pilot Duty 125 VA at 120 or 240 VAC 60 Hz
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	
240 VAC	5.1	30.6	

Dimensions, in. (mm)

A NPT	B	C	D NPT	E	F	G	H	J
1 (25)	6½ (165)	2⅞ (65)	1 (25)	5⅝ (131)	9⅜ (238)	3⅛ (79)	10½ (267)	5⅞ (130)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
63	142400	Low water cut-off	13.5 (6.1)
63-B	142700	63 w/ float block	15.0 (6.8)
63-BM	143300	63 w/float block & manual reset	15.0 (6.8)
63-E	142500	63 w/BSPT threads	14.0 (6.4)
63-EM	142800	63-E w/manual reset	14.0 (6.4)
63-EP	142850	63-E w/1" (25mm) NPT plug	14.0 (6.4)
63-M	143100	63 w/manual reset	14.0 (6.4)
E-28	142900	63 w/DPDT switch	14.3 (6.5)

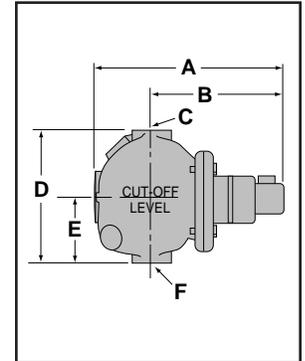
Low Water Cut-Offs – Float Type For Steam Boilers

Series 64



Low Water Cut-Offs

- For residential, commercial, and industrial applications
- For boilers of any steaming capacity
- Heavy Duty
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Packless bellows
- Optional manual reset available
- 1" (25mm) NPT equalizing pipes required
- Maximum boiler pressure 50 psi (3.5 kg/cm²)



Dimensions, in. (mm)

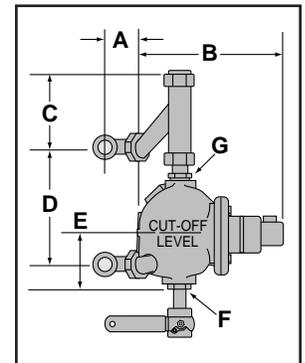
A	B	C NPT	D	E	F NPT
9 ¹⁵ / ₁₆ (252)	7 ⁷ / ₁₆ (65)	1 (25)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	1 (25)

Model 64-A



Low Water Cut-Offs

- Quick hook-up fittings provided for installation directly into gauge glass tappings



Dimensions, in. (mm)

A	B	C	D		E	F NPT	G NPT
			min.	max.			
2 ⁵ / ₈ (66)	9 ¹⁵ / ₁₆ (252)	4 ¹ / ₂ (113)	6 ⁷ / ₈ (172)	13 ³ / ₈ (339)	3 ¹ / ₈ (79)	1 (25)	1 (25)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
64	143600	Low water cut-off	11.3 (5.1)
64-A	143700	64 w/quick hook-up fittings	18.3 (8.3)
64-B	143800	64 w/float block	11.5 (5.2)
64-M	144250	64 w/manual reset	12.5 (5.7)

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

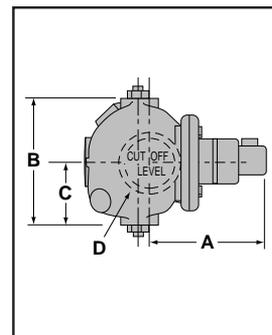
Low Water Cut-Offs – Float Type For Steam Boilers (continued)

Series 764



Low Water Cut-Offs

- For residential, commercial and industrial applications
- For boilers of any steaming capacity
- Heavy duty
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Packless bellows
- 2½" (65mm) NPT side tapping provided for installation with close nipple
- Maximum boiler pressure 50 psi (3.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D NPT
6 ⁷ / ₈ (175)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	2 ¹ / ₂ (65)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
764	144500	Low water cut-off	12.5 (5.7)

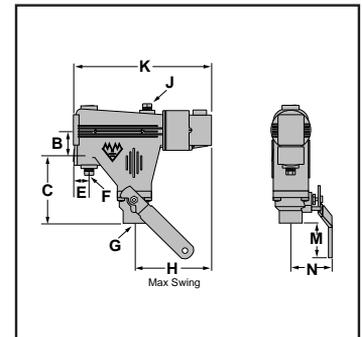
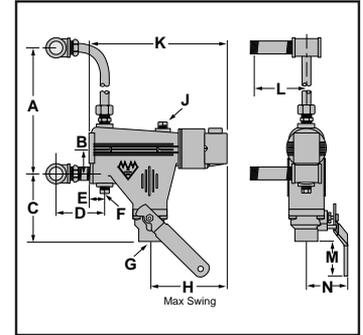
Low Water Cut-Offs – Float Type For Steam Boilers

Series 67



Low Water Cut-Offs

- For residential and commercial applications
- For boilers of any steaming capacity
- Quick hook-up fittings provided
- Lever-operated, full port ball valve for easy blow down
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Optional features
 - Low voltage switches for self-generating millivolt circuits
 - Manual reset switch
- Large float chamber
- Maximum steam pressure 20 psi (1.4 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A		B	C	D	E	F	G	H	J	K	L	M	N
min.	max.					NPT	NPT		NPT				
6½ (165)	14 (356)	1¾ (45)	4¾ (121)	3⅝ (86)	1⅞ (29)	¾ (12)	¾ (20)	5½ (140)	¼ (8)	9 ²³ / ₃₂ (247)	3 ⁹ / ₁₆ (90)	2½ (64)	2 ¹³ / ₁₆ (71)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
67	149400	Low water cut-off	10 (4.5)
67-G	149600	67 for millivolt service	10 (4.5)
67-LQHU	149500	67 without quick hook-up fittings	8 (3.6)
67-M	149700	67 w/manual reset	10 (4.5)
67-T	153250	67 w/½" (15mm) NPT brass union	10 (4.5)

BOILER CONTROLS

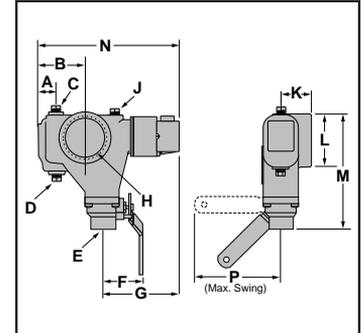
Low Water Cut-Offs – Float Type For Steam Boilers (continued)

Series 767



Low Water Cut-Offs

- For residential and commercial low pressure boiler applications
- For boilers of any steaming capacity
- 2½" (65mm) NPT body tapping for side mounting on boilers
- Lever-operated, full port ball valve for easy blow down
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Large float chamber
- Maximum steam pressure 20 psi (1.4 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C NPT	D NPT	E NPT	F	G	H NPT	J NPT	K	L	M	N	P
1 ⁵ / ₃₂ (29.3)	3 ¹³ / ₃₂ (186.5)	3/8 (12)	3/8 (12)	3/4 (20)	2 ¹³ / ₁₆ (71)	5 ³ / ₈ (137)	2 ¹ / ₂ (65)	1/4 (8)	2 ³ / ₆₄ (51.9)	3 ⁵ / ₈ (92)	8 ⁵ / ₃₂ (207)	9 ¹¹ / ₁₆ (246.6)	5 ¹ / ₂ (140)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
767	153700	Low water cut-off	8.5 (3.9)

Low Water Cut-Offs – Float Type For Steam Boilers

Series 69

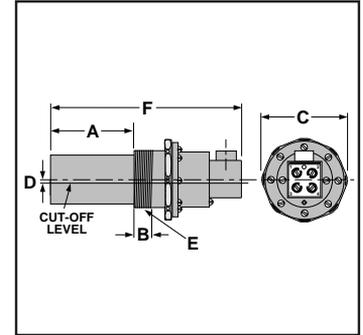


Built-in Low Water Cut-Offs

- For residential and commercial low pressure steam boiler applications
- For boilers of any steaming capacity
- For mounting in 2½" (65mm) NPT boiler side tapplings
- Insertion lengths available in 1¾" - 4½" (30-105mm)
- Packless bellows
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and an alarm or electric water feeder
- Optional low voltage switches for self-generating millivolt circuits
- Maximum steam pressure 20 psi (1.4 kg/cm²)



Series 69



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

Model	Insertion Length	B	C	D	E	F
69	4½ (105)					
169	3½ (79)					
269	2¼ (57)	1 (25)	4½ (105)	⅞ (3)	2½ (65)	9½ (241)
369	1¾ (45)					
469, 569	1¾ (30)					

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
69	153900	Low water cut-off w/4½" (105mm) insertion length	3.7 (1.7)
69-J	154210	69 w/BSPT threads	3.7 (1.7)
69-MV-P	155000	69 w/millivolt switch	4.0 (1.8)
169	155100	69 w/3½" (79mm) insertion length	4.0 (1.8)
269	155200	69 w/2¼" (57mm) insertion length	4.0 (1.8)
369	155300	69 w/1¾" (45mm) insertion length	4.0 (1.8)
469	155500	69 w/1¾" (30mm) insertion length	4.0 (1.8)
569	155700	469 w/1¾" (30mm) insertion length w/¼" NPT tapping	4.0 (1.8)

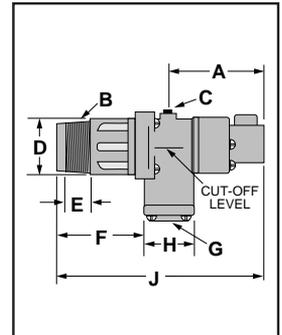
Low Water Cut-Offs – Float Type For Steam Boilers (continued)

Series 70



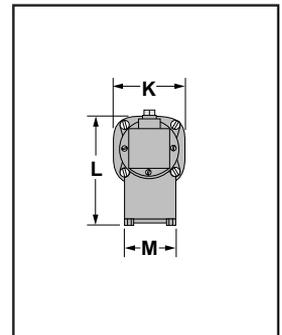
Low Water Cut-Offs

- For residential and commercial low pressure boiler applications
- For boilers of any steaming capacity
- For mounting in 2½" (65mm) NPT boiler side tapplings
- Adjustable BX outlet for easy installation
- Dual precision switches for dependable operation of the low water cut-off and alarm or electric water feeder
- Float chamber provided
- ¼" (8mm) NPT pressure control tapping provided
- Maximum steam pressure 20 psi (1.4 kg/cm²)



Dimensions, in. (mm)

A	B NPT	C NPT	D	E	F	G NPT
4½ (114)	2½ (65)	¼ (8)	3 (76)	1 (25)	4⅛ (105)	¾ (20)
H	J	K	L	M		
2⅜ (60)	9⅓ (249)	3¼ (83)	5⅙ (129)	2⅜ (60)		



Model 70-B

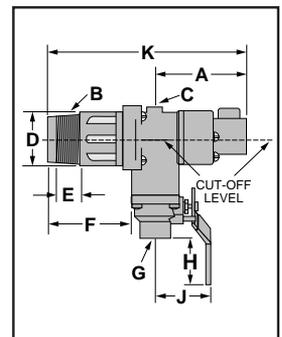


Low Water Cut-Offs

- Lever-operated, full port ball valve for easy blow down

Dimensions, in. (mm)

A	B NPT	C NPT	D	E	F	G NPT
4½ (114)	2½ (65)	¼ (8)	3 (76)	1 (25)	4⅛ (105)	¾ (20)
H	J	K	L	M	N	
2½ (64)	2⅓ (71)	9⅓ (249)	7 (178)	3¼ (83)	5½ (140)	

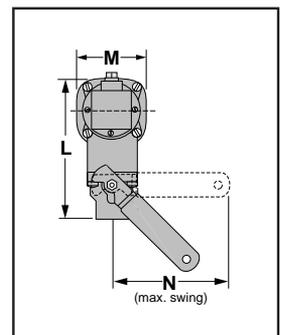


Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
70	155800	Low water cut-off	6.7 (3.0)
70-B	155900	70 w/blow down valve	8.0 (3.6)



Low Water Cut-Offs – Float Type For Steam Boilers

Series 150S



Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Snap action switches for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - 2 Single pole, single throw switches
 - 2 Single pole, double throw switches
 - Float block
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)

Model 150S-MD

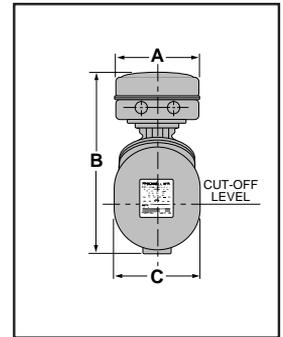
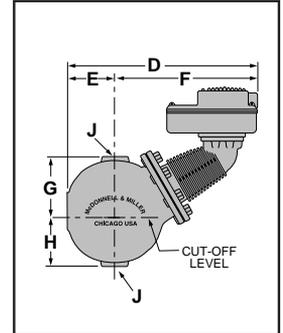
Maximum differential operation

- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)



Series 150S

with MECURY FREE
Snap-Action
Switches



Electrical Ratings

Voltage	Pump Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
150S	171702	Combination low water cut-off/pump controller	24.7 (11.2)
150S-B	171903	150S w/float block	24.7 (11.2)
150S-B-M	172104	150S-B w/manual reset	24.7 (11.2)
150S-J	172601	150S w/BSPT threads	24.7 (11.2)
150S-MD	173603	150S w/maximum differential	24.7 (11.2)
150S-M	172702	150S w/manual reset	24.7 (11.2)
150S-M-MD	172802	150S-M w/maximum differential	24.7 (11.2)
150S-J-M	172901	150S-M w/BSPT threads	24.7 (11.2)
158S	178402	150S w/2 SPDT switches	26.3 (11.9)
158S-M	178502	158S w/manual reset	27.3 (12.4)
159S	178802	150S w/2 SPST switches	26.0 (11.8)

Dimensions, in. (mm)

A	B	C	D
5 ⁷ / ₈ (149)	12 ¹⁷ / ₁₆ (316)	6 (152)	13 ¹ / ₄ (337)

E	F	G	H	J
3 ⁵ / ₁₆ (84)	9 ¹⁵ / ₁₆ (252)	4 ¹ / ₈ (105)	3 ⁷ / ₁₆ (87)	1 (25) NPT

BOILER CONTROLS

Low Water Cut-Offs – Float Type For Steam Boilers (continued)

Series 150 Low Water Cut-Offs

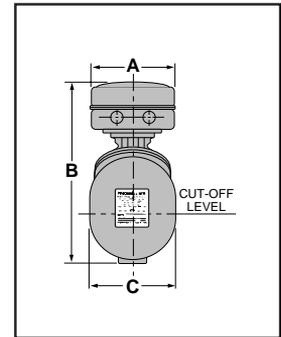
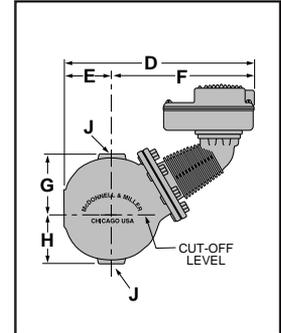


- For commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Mercury switches for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - 2 Single pole, single throw switches
 - 2 Single pole, double throw switches
 - Float block
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)

Model 150-MD

Maximum differential operation

- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)



BOILER CONTROLS

Electrical Ratings

Voltage	Cut-off and Pump Circuits Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
150	171700	Combination low water cut-off/pump controller	24.7 (11.2)
150-B	171900	150 w/float block	24.7 (11.2)
150-B-M	172100	150-B w/manual reset	24.7 (11.2)
150-J	172600	150 w/BSPT threads	24.7 (11.2)
150-MD	171800	150 w/maximum differential	24.7 (11.2)
150-M	172700	150 w/manual reset	24.7 (11.2)
150-M-MD	172800	150-M w/maximum differential	24.7 (11.2)
150-J-M	172900	150-M w/BSPT threads	24.7 (11.2)
158	178400	150 w/2 SPDT switches	26.3 (11.9)
158-M	178500	158 w/manual reset	27.3 (12.4)
159	178800	150 w/2 SPST switches	26.0 (11.8)

Dimensions, in. (mm)

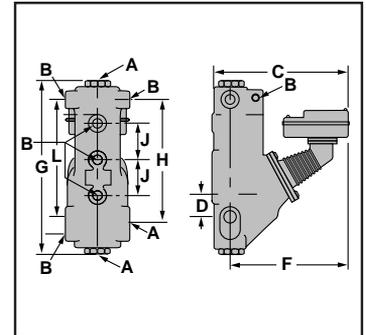
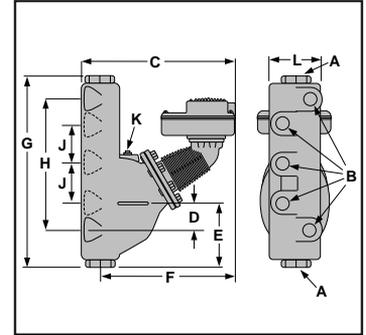
A	B	C	D	E
5 ⁷ / ₈ (149)	12 ¹⁷ / ₁₆ (316)	6 (152)	13 ¹ / ₄ (337)	3 ⁵ / ₁₆ (84)
F	G	H	J	
9 ¹⁵ / ₁₆ (252)	4 ¹ / ₈ (105)	3 ⁷ / ₁₆ (87)	1 (25)	NPT

Low Water Cut-Offs – Float Type For Steam Boilers

Series 157S
Low Water Cut-Offs



- For residential, commercial and industrial low or high pressure boiler applications
 - For boilers of any steaming capacity
 - Monel bellows provides corrosion resistance
 - Float chamber with integral water column provided
 - Snap action for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
 - Optional features
 - Manual reset
 - Integral conductance probes for additional levels and greater operating differential-Model 157S-RBP-MD
 - 1" or 1 1/4" (25-32mm) NPT equalizing tappings
 - 1/2" or 3/4" (15-20mm) NPT tappings for gauge glass/tri-cock installations
 - BSPT threads
 - Maximum pressure 150 psi (10.5 kg/cm²)
- Model 157S-MD**
Maximum differential operation
- Prevents nuisance burner shutdowns in **low pressure** applications
 - Maximum operating pressure 50 psi (3.5 kg/cm²)



Electrical Ratings

Voltage	Cut-off and Pump Circuits Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
157S	173502	150S low water cut-off w/water column	39.7 (18.0)
157S-MD	173603	157S w/maximum differential	39.7 (18.0)
157S-A	173702	157S w/alternate tappings	39.5 (17.9)
157S-A-M	173802	157S-A w/manual reset	39.5 (17.9)
157S-M	175402	157S w/manual reset	39.7 (18.0)
157S-M-MD	175412	157S-M w/maximum differential	39.7 (18.0)
157S-R	176220	157S w/alternate tappings	42.0 (19.0)
157S-R-M	177306	157S-R w/manual reset	42.0 (19.0)
157S-RBP-MD	176503	157S w/2 integral conductance probes	51.0 (23.1)
157S-RL	176902	157S w/alternate tappings	42.0 (19.0)
157S-RL-M	177006	157S-RL w/manual reset	42.0 (19.0)

Dimensions, in. (mm)

Model	A NPT	B NPT	C	D	E	F	G	H	J	K NPT	L
157S	1 (25)	1/2 (15)	13 3/8 (339)	2 5/16 (59)	4 15/16 (125)	11 3/4 (298)	16 (406)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	5 7/8 (149)
157S-A	1 1/4 (32)	3/4 (20)	13 3/8 (339)	2 5/16 (59)	4 15/16 (125)	11 3/4 (298)	16 (406)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	5 7/8 (149)
157S-R	1 (25)	1/2 (15)	13 3/8 (339)	2 1/4 (57)	5 7/8 (149)	11 3/4 (298)	17 (432)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	6 1/4 (159)
157S-RL	1 1/4 (32)	1/2 (15)	13 3/16 (345)	3 1/2 (89)	5 7/8 (149)	11 3/4 (298)	17 (432)	12 3/4 (324)	3 1/2 (89)	3/4 (20)	6 1/4 (159)
157S-RBP-MD	1 (25)	1/2 (15)	13 3/16 (345)	2 1/4 (57)	5 7/8 (149)	11 3/4 (298)	17 (432)	11 1/2 (292)	3 1/2 (89)	NA	12 1/4 (324)

Low Water Cut-Offs – Float Type For Steam Boilers (continued)

Series 157



Low Water Cut-Offs

- For residential, commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Float chamber with integral water column provided
- Mercury for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - Integral conductance probes for additional levels and greater operating differential-Model 157-RBP-MD
 - 1" or 1¼" (25-32mm) NPT equalizing tappings
 - ½" or ¾" (15-20mm) NPT tappings for gauge glass/tri-cock installations
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)

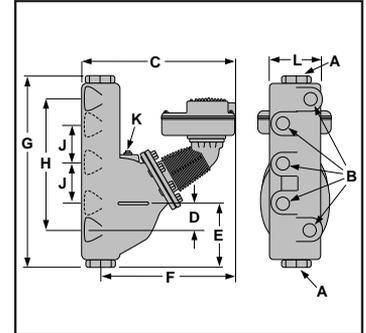
Model 157-MD

Maximum differential operation

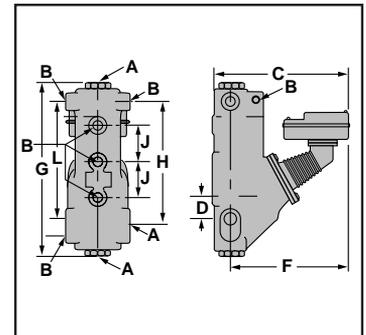
- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)



Series 157



Model 157-RBP-MD



Electrical Ratings

Voltage	Cut-off and Pump Circuits Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at
240 VAC	3.7	22.2	120 or 240 VAC

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
157	173500	150 low water cut-off w/water column	39.7 (18.0)
157-MD	173600	157 w/maximum differential	39.7 (18.0)
157-A	173700	157 w/alternate tappings	39.5 (17.9)
157-A-M	173800	157-A w/manual reset	39.5 (17.9)
157-M	175400	157 w/manual reset	39.7 (18.0)
157-M-MD	175410	157-M w/maximum differential	39.7 (18.0)
157-R	176200	157 w/alternate tappings	42.0 (19.0)
157-R-M	177300	157-R w/manual reset	42.0 (19.0)
157-RBP-MD	176501	157 w/2 integral conductance probes	51.0 (23.1)
157-RL	176900	157 w/alternate tappings	42.0 (19.0)
157-RL-M	177000	157-RL w/manual reset	42.0 (19.0)

Dimensions, in. (mm)

Model	A NPT	B NPT	C	D	E
157	1 (25)	½ (15)	13¾ (339)	2 ⁵ / ₁₆ (59)	4 ¹⁵ / ₁₆ (125)
157-A	1¼ (32)	¾ (20)	13¾ (339)	2 ⁵ / ₁₆ (59)	4 ¹⁵ / ₁₆ (125)
157-R	1 (25)	½ (15)	13¾ (339)	2¼ (57)	5 ⁷ / ₈ (149)
157-RL	1¼ (32)	½ (15)	13 ³ / ₁₆ (345)	3½ (89)	5 ⁷ / ₈ (149)

Model	F	G	H	J	K NPT	L
157	11¾ (298)	16 (406)	11½ (292)	3½ (89)	¾ (20)	5 ⁷ / ₈ (149)
157-A	11¾ (298)	16 (406)	11½ (292)	3½ (89)	¾ (20)	5 ⁷ / ₈ (149)
157-R	11¾ (298)	17 (432)	11½ (292)	3½ (89)	¾ (20)	6¼ (159)
157-RL	11¾ (298)	17 (432)	12¾ (324)	3½ (89)	¾ (20)	6¼ (159)

BOILER CONTROLS

Low Water Cut-Offs

Combination Low Water Cut-Off/Pump Controllers for Steam Boilers

Series 42

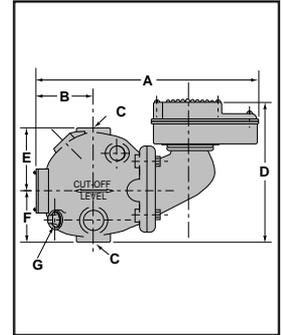


Low Water Cut-Off/Pump Controllers

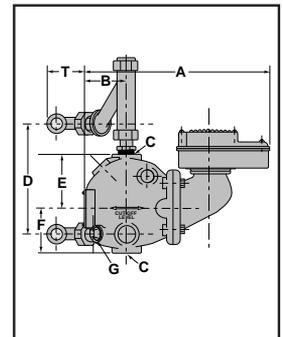
- For residential, commercial, and industrial low and medium pressure steam boilers with a separate water column
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Single pole, single throw mercury switches
- Enclosed junction box protects switches
- Optional features
 - Quick hook-up fittings
 - Gauge glass connector
 - BSPT threads
- Maximum pressure 50 psi (3.5 kg/cm²)



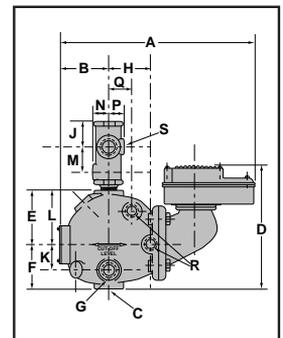
SERIES 42



MODEL 42-A



MODEL 42-N



Electrical Ratings

Voltage	Pump Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
42	129300	Combination low water cut-off/pump controller	15.5 (7.0)
42-A	129700	42 w/quick hook-up fittings	21.3 (9.7)
42-J	129400	42 w/BSPT threads	15.5 (7.0)
42-N	129800	42 w/glass connector	21.3 (9.7)

Dimensions, in. (mm)

Model	A	B	C NPT	D	E	F	G NPT
42	12 ¹ / ₄ (311)	2 ⁹ / ₁₆ (65)	1 (25)	8 ⁷ / ₈ (225)	3 ¹¹ / ₁₆ (94)	3 ¹ / ₈ (79)	1 ¹ / ₂ (15)
42-A	12 ¹ / ₄ (311)	2 ⁹ / ₁₆ (65)	1 (25)	7 ¹ / ₄ -16 ¹¹ / ₁₆ (184-347)	2 ³ / ₄ (45)	3 ¹ / ₈ (79)	1 ¹ / ₂ (15)
42-N	12 ¹ / ₄ (311)	2 ⁹ / ₁₆ (65)	1 (25)	8 ⁷ / ₈ (225)	3 ¹¹ / ₁₆ (94)	3 ¹ / ₈ (79)	1 ¹ / ₂ (15)

Model	H	J	K	L	M	N	P	Q	R NPT	S NPT	T
42-N	2 ⁹ / ₁₆ (65)	2 ⁹ / ₁₆ (65)	1 ³ / ₄ (45)	3 ¹¹ / ₁₆ (94)	1 ¹³ / ₁₆ (46)	1 ¹ / ₁₆ (27)	1 ¹ / ₁₆ (27)	1 ¹ / ₂ (38)	3 ³ / ₈ (12)	1 ¹ / ₄ (8)	2 ⁵ / ₈ (67)

Low Water Cut-Offs

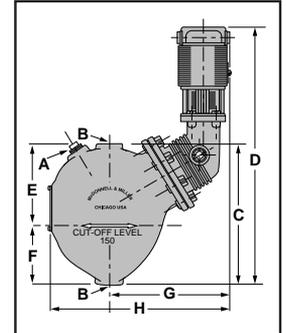
Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

Series 93



Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure steam boilers
- Maintains consistent water level regardless of pressure
- For boilers of any steaming capacity
- No. 5 Switch included
- Magnetic repulsion eliminates need for bellows
- Optional features
 - Manual reset
 - On/Off or proportional control switch to maintain constant boiler water level
 - BSPT threads
- 1" (25mm) NPT connections
- Maximum pressure 150 psi (10.5 kg/cm²)



BOILER CONTROLS

Electrical Ratings

345 VA at 120 or 240 VAC

Dimensions, in. (mm)

A NPT	B NPT	C	D	E	F	G	H
3/4 (20)	1 (25)	10 1/16 (256)	18 5/8 (473)	4 15/32 (113.5)	5 19/32 (142)	8 7/8 (225)	12 7/8 (327)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
93	162300	Combination low water cut-off/pump controller w/No. 5 switch	35.0 (15.9)
93-J	162325	93 w/BSPT threads	35.0 (15.9)
93-J-7B	162330	93 w/BSPT threads & No. 7-B switch	35.5 (16.0)
93-M	162500	93 w/manual reset	35.0 (15.9)
93-MJ	162525	93-M w/BSPT threads	35.0 (15.9)
93-7B	143300	93 w/No. 7B switch	35.5 (16.0)
93-7B-M	163100	93-7B W/manual reset	35.5 (16.0)

Low Water Cut-Offs

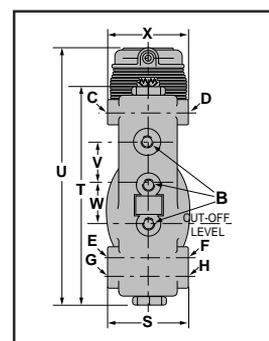
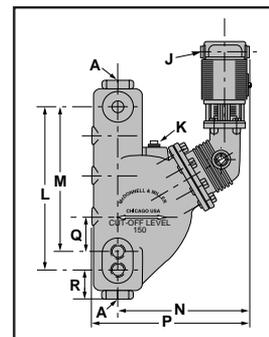
Combination Low Water Cut-Off/Pump Controllers for Steam Boilers

Series 193



Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure steam boilers
- Maintains consistent water level regardless of pressure
- Water column with integral tapplings for gauge glass and tri-cock installations
- For boilers of any steaming capacity
- No. 5 Switch included
- Magnetic repulsion eliminates need for bellows
- Optional features
 - Manual reset
 - On/Off or proportional control switch to maintain constant boiler output
- 1" (25mm) NPT connections
- Maximum pressure 150 psi (10.5 kg/cm²)



Dimensions, in. (mm)

Model	A NPT	B NPT	C NPT	D NPT	E NPT	F NPT	G NPT	H NPT	J NPT	K NPT
193	1 (25)	1/2 (15)	1/2 (15)	1/2 (15)	–	–	1/2 (15)	1/2 (15)	1/2 (15)	3/4 (20)
193-A	1 (25)	1/2 (15)	1/2 (15)	1/2 (15)	1/2 (15)	1/2 (15)	–	–	1/2 (15)	3/4 (20)
193-B	1 1/4 (32)	3/4 (20)	3/4 (20)	3/4 (20)	–	–	3/4 (20)	3/4 (20)	1/2 (15)	3/4 (20)
193-D	1 (25)	1/2 (15)	1 (25)	1/2 (15)	1 (25)	1/2 (15)	–	–	1/2 (15)	3/4 (20)

Model	L	M	N	P	Q	R
193	12 3/4 (324)	–	10 13/16 (274)	13 (330)	–	2 7/8 (73)
193-A	–	11 1/2 (292)	10 13/16 (274)	13 (330)	2 1/4 (57)	–
193-B	12 3/4 (324)	–	10 13/16 (274)	13 (330)	–	2 7/8 (73)
193-D	–	11 1/2 (292)	10 13/16 (274)	13 (330)	2 1/4 (57)	–

Model	S	T	U	V	W	X
193	6 3/4 (171.4)	17 1/2 (445)	20 1/2 (521)	3 1/2 (89)	3 1/2 (89)	6 (152)
193-A	6 3/4 (171.4)	17 1/2 (445)	20 1/2 (521)	3 1/2 (89)	3 1/2 (89)	6 (152)
193-B	6 3/4 (171.4)	17 1/2 (445)	20 1/2 (521)	3 1/2 (89)	3 1/2 (89)	6 (152)
193-D	6 3/4 (171.4)	17 1/2 (445)	20 1/2 (521)	3 1/2 (89)	3 1/2 (89)	6 (152)

BOILER CONTROLS

Low Water Cut-Offs Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

Series 193 (continued)

Low Water Cut-Off/Pump Controllers

Electrical Ratings

345 VA at 120 or 240 VAC

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
193	163400	Combination low water cut-off/pump controller w/No. 5 switch	52.5 (23.8)
193-A	163500	193 w/alternate tapplings	52.5 (23.8)
193-A-7B	164500	193-A w/No. 7B switch	52.5 (23.8)
193-A-7BM	164600	193-A-7B w/manual reset	52.5 (23.8)
193-A-M	164200	193-A w/manual reset	52.5 (23.8)
193-B	163600	193 w/alternate tapplings	52.5 (23.8)
193-B-7B	164700	193-B w/No. 7B switch	52.5 (23.8)
193-D	163900	193 w/alternate tapplings	52.5 (23.8)
193-D-7B	163903	193-D w/No. 7B switch	52.5 (23.8)
193-M	164100	193 w/manual reset	52.5 (23.8)
193-7B	164400	193 w/No. 7B switch	52.5 (23.8)
193-7BM	164525	193-7B w/manual reset	52.5 (23.8)

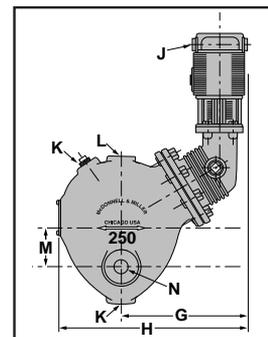
Low Water Cut-Offs Combination Low Water Cut-Off/Pump Controllers for Steam Boilers

Series 94



Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure steam boilers
- Maintains consistent water level regardless of pressure
- For boilers of any steaming capacity
- No. 5 Switch included
- Magnetic repulsion eliminates need for bellows
- Optional features
 - Manual reset
 - On/Off or proportional control switch to maintain constant boiler water level
 - BSPT threads
- 1 1/4" (32mm) NPT connections
- Maximum pressure 250 psi (17.6 kg/cm²)

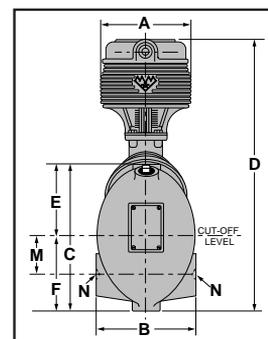


Electrical Ratings

345 VA at 120 or 240 VAC

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
94	165200	Combination low water cut-off/pump controller w/No. 5 switch	52.5 (23.8)
94-A	165500	94 w/alternate tapplings	50.3 (22.8)
94-AM	165800	94-A w/manual reset	50.3 (22.8)
94-A-7B	165700	94-AM w/No. 7B switch	52.5 (23.8)
94-J	165850	94 w/BSPT threads	52.5 (23.8)
94-J-7B	165875	94-7B w/BSPT threads	52.0 (23.6)
94-M	165900	94 w/manual reset	52.5 (23.8)
94-7B	166300	94 w/No. 7B switch	52.0 (23.6)



Dimensions, in. (mm)

Model	A	B	C	D
94	6 (152)	7 (178)	10 ⁹ / ₁₆ (268)	18 ¹³ / ₁₆ (478)
94-A	6 (152)	7 (178)	10 ⁹ / ₁₆ (268)	18 ¹³ / ₁₆ (478)

Model	E	F	G	H
94	5 ⁷ / ₈ (149)	4 ¹¹ / ₁₆ (119)	8 ³ / ₄ (222)	12 ¹⁵ / ₁₆ (328.6)
94-A	5 ⁷ / ₈ (149)	4 ¹¹ / ₁₆ (119)	8 ³ / ₄ (222)	12 ¹⁵ / ₁₆ (328.6)

Model	J	K NPT	L NPT	M	N
94	1/2 (15)	1 1/4 (32)	1 1/4 (32)	–	–
94-A	1/2 (15)	1 1/4 (32)	1 1/4 (32)	2 1/16 (52)	1 1/4 (32)

BOILER CONTROLS

Low Water Cut-Offs

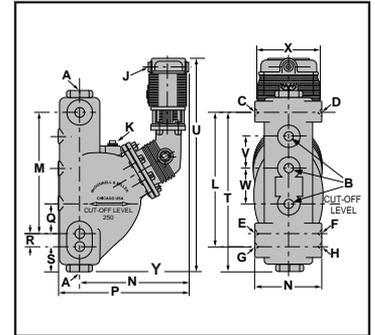
Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

Series 194



Low Water Cut-Off/Pump Controllers

- For commercial, and industrial low or high pressure steam boilers
- Maintains consistent water level regardless of pressure
- For boilers of any steaming capacity
- Water column with integral tapplings for gauge glass and tri-cock installations
- No. 5 Switch included
- Magnetic repulsion eliminates need for bellows
- Optional features
 - Manual reset
 - No. 7-B On/Off or proportional control switch to maintain constant boiler water level
- 1 1/4" (32mm) NPT connections
- Maximum pressure 250 psi (17.6 kg/cm²)



Electrical Ratings

345 VA at 120 or 240 VAC

Dimensions, in. (mm)

Model	A NPT	B NPT	C NPT	D NPT	E NPT	F NPT	G NPT	H NPT	J NPT	K NPT
194	1 1/4 (32)	1/2 (15)	1/2 (15)	1/2 (15)	1/2 (15)	1/2 (15)	–	–	1/2 (15)	3/4 (20)
194-A	1 1/4 (32)	1/2 (15)	1/2 (15)	1/2 (15)	–	–	1/2 (15)	1/2 (15)	1/2 (15)	3/4 (20)

Model	L	M	N	P	Q	R	S
194	–	11 5/8 (295)	6 3/4 (171.4)	13 1/16 (332)	2 13/16 (71)	2 13/16 (71)	2 3/8 (60)
194-A	12 7/8 (327)	–	6 3/4 (171.4)	13 1/16 (332)	2 13/16 (71)	–	2 3/8 (60)

Model	T	U	V	W	X	Y
194	17 1/4 (438)	20 1/2 (521)	3 (76)	3 (76)	6 (152)	10 13/16 (274)
194-A	17 1/4 (438)	20 1/2 (521)	3 (76)	3 (76)	6 (152)	10 13/16 (274)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
194	166600	Combination low water cut-off/pump controller w/ Series 5 switch	72.0 (32.7)
194-A	166700	194 w/alternate tapplings	72.0 (32.7)
194-A-7B	167100	194-A w/ Series 7B switch	72.0 (32.7)
194-M	166900	194 w/manual reset	72.0 (32.7)
194-7B	167200	194 w/ Series 7B switch	72.0 (32.7)
194-7BM	167300	194-7B w/manual reset	72.0 (32.7)

BOILER CONTROLS

Low Water Cut-Offs Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

Series 150S

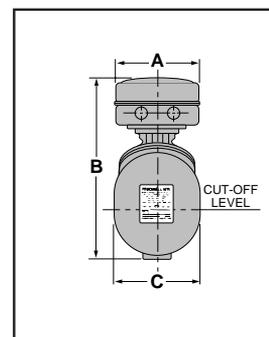
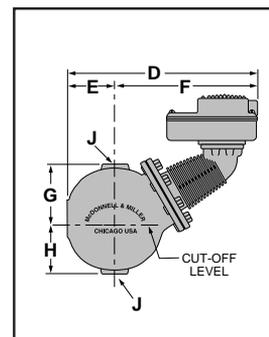
Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Snap action switches for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - 2 Single pole, single throw switches
 - 2 Single pole, double throw switches
 - Float block
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)



Series 150S

with **MECURY FREE**
Snap-Action
Switches



Model 150S-MD

Maximum differential operation

- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)

Electrical Ratings

Voltage	Pump Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
150S	171702	Combination low water cut-off/pump controller	24.7 (11.2)
150S-B	171903	150S w/float block	24.7 (11.2)
150S-B-M	172104	150S-B w/manual reset	24.7 (11.2)
150S-J	172601	150S w/BSPT threads	24.7 (11.2)
150S-MD	173603	150S w/maximum differential	24.7 (11.2)
150S-M	172702	150S w/manual reset	24.7 (11.2)
150S-M-MD	172802	150S-M w/maximum differential	24.7 (11.2)
150S-J-M	172901	150S-M w/BSPT threads	24.7 (11.2)
158S	178402	150S w/2 SPDT switches	26.3 (11.9)
158S-M	178502	158S w/manual reset	27.3 (12.4)
159S	178802	150S w/2 SPST switches	26.0 (11.8)

Dimensions, in. (mm)

A	B	C	D
5 ⁷ / ₈ (149)	12 ¹⁷ / ₁₆ (316)	6 (152)	13 ¹ / ₄ (337)

E	F	G	H	J
3 ⁵ / ₁₆ (84)	9 ¹⁵ / ₁₆ (252)	4 ¹ / ₈ (105)	3 ⁷ / ₁₆ (87)	1 (25) NPT

BOILER CONTROLS

Low Water Cut-Offs Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

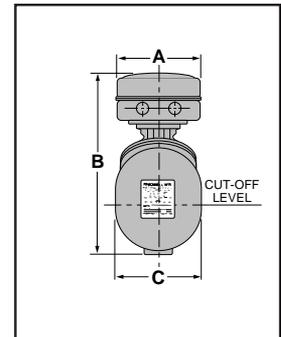
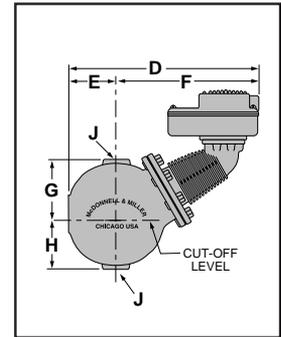
Series 150

Low Water Cut-Off/Pump Controllers

- For commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Mercury switches for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - 2 Single pole, single throw switches
 - 2 Single pole, double throw switches
 - Float block
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)

Model 150-MD

- Maximum differential operation**
- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)



Electrical Ratings

Voltage	Pump Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
150	171700	Combination low water cut-off/pump controller	24.7 (11.2)
150-B	171900	150 w/float block	24.7 (11.2)
150-B-M	172100	150-B w/manual reset	24.7 (11.2)
150-J	172600	150 w/BSPT threads	24.7 (11.2)
150-MD	171800	150 w/maximum differential	24.7 (11.2)
150-M-MD	172700	150 w/manual reset	24.7 (11.2)
150-M-MD	172800	150-M w/maximum differential	24.7 (11.2)
150-J-M	172900	150-M w/BSPT threads	24.7 (11.2)
158	178400	150 w/2 SPDT switches	26.3 (11.9)
158-M	178500	158 w/manual reset	27.3 (12.4)
159	178800	150 w/2 SPST switches	26.0 (11.8)

Dimensions, in. (mm)

A	B	C	D
5 ⁷ / ₈ (149)	12 ¹⁷ / ₁₆ (316)	6 (152)	13 ¹ / ₄ (337)

E	F	G	H	J
3 ⁵ / ₁₆ (84)	9 ¹⁵ / ₁₆ (252)	4 ¹ / ₈ (105)	3 ⁷ / ₁₆ (87)	1 (25) NPT

BOILER CONTROLS

Low Water Cut-Offs

Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

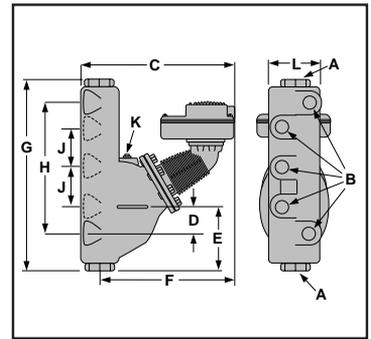
Series 157S
 Low Water Cut-Off/Pump Controllers

with
MERCURY FREE
 Snap-Action Switches

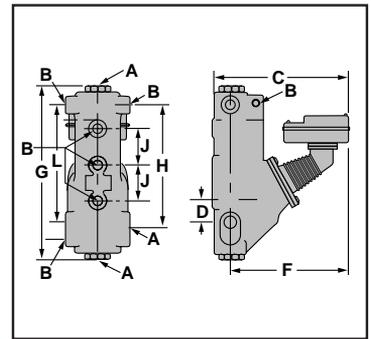
- For residential, commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Float chamber with integral water column provided
- Snap action switches for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - Integral conductance probes for additional levels and greater operating differential - Model 157S-RBP-MD
 - 1" or 1 1/4" (25-32mm) NPT equalizing tappings
 - 1/2" or 3/4" (15-20mm) NPT tappings for gauge glass/tri-cock installations
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)



Series 157S



Series 157S-RBP-MD



Model 157S-MD

Maximum differential operation

- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)

Electrical Ratings

Voltage	Pump Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)		
Voltage	Amps	
120 VAC	1	
240 VAC	1/2	

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
157S	173502	150S low water cut-off w/water column	39.7 (18.0)
157S-MD	173603	157S w/maximum differential	39.7 (18.0)
157S-A	173702	157S w/alternate tappings	39.5 (17.9)
157S-A-M	173802	157S-A w/manual reset	39.5 (17.9)
157S-M	175402	157S w/manual reset	39.7 (18.0)
157S-M-MD	175412	157S-M w/maximum differential	39.7 (18.0)
157S-R	176220	157S w/alternate tappings	42.0 (19.0)
157S-R-M	177306	157S-R w/manual reset	42.0 (19.0)
157S-RBP-MD	176503	157S w/2 integral conductance probes	51.0 (23.1)
157S-RL	176902	157S w/alternate tappings	42.0 (19.0)
157S-RL-M	177006	157S-RL w/manual reset	42.0 (19.0)

Dimensions, in. (mm)

Model	A NPT	B NPT	C	D	E	F	G	H	J	K NPT	L
157S	1 (25)	1/2 (15)	13 9/16 (345)	2 5/16 (59)	4 15/16 (125)	11 3/4 (298)	16 (406)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	5 7/8 (149)
157S-A	1 1/4 (32)	3/4 (20)	13 9/16 (345)	2 5/16 (59)	4 15/16 (125)	11 3/4 (298)	16 (406)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	5 7/8 (149)
157S-R	1 (25)	1/2 (15)	13 9/16 (345)	2 1/4 (57)	5 7/8 (149)	11 3/4 (298)	17 (432)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	6 1/4 (159)
157S-RL	1 1/4 (32)	1/2 (15)	13 9/16 (345)	3 1/2 (89)	5 7/8 (149)	11 3/4 (298)	17 (432)	12 3/4 (324)	3 1/2 (89)	3/4 (20)	6 1/4 (159)
157S-RBP-MD	1 (25)	1/2 (15)	13 9/16 (345)	2 1/4 (57)	5 7/8 (149)	11 3/4 (298)	17 (432)	11 1/2 (292)	3 1/2 (89)	N/A	12 3/4 (324)

BOILER CONTROLS

Low Water Cut-Offs

Combination Low Water Cut-Off/Pump Controllers for Steam Boilers (cont.)

Series 157



Low Water Cut-Off/Pump Controllers

- For residential, commercial and industrial low or high pressure boiler applications
- For boilers of any steaming capacity
- Monel bellows provides corrosion resistance
- Float chamber with integral water column provided
- Mercury switches for high temperature service
 - 1 Single pole, single throw switch for pump control
 - 1 Single pole, double throw switch for low water cut-off and alarm actuation
- Optional features
 - Manual reset
 - Integral conductance probes for additional levels and greater operating differential-Model 157-RPB-MD
 - 1" or 1 1/4" (25-32mm) NPT equalizing tappings
 - 1/2" or 3/4" (15-20mm) NPT tappings for gauge glass/tri-cock installations
 - BSPT threads
- Maximum pressure 150 psi (10.5 kg/cm²)

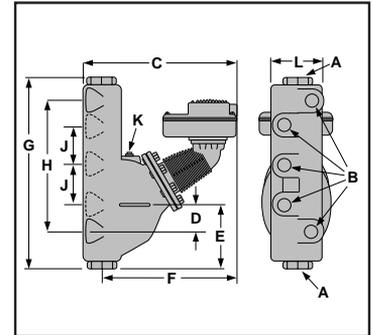
Model 157-MD

Maximum differential operation

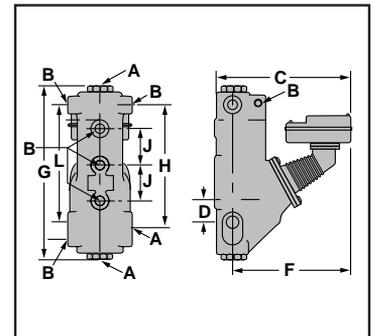
- Prevents nuisance burner shutdowns in **low pressure** applications
- Maximum operating pressure 50 psi (3.5 kg/cm²)



Series 157



Series 157-RPB-MD



Electrical Ratings

Voltage	Pump Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Alarm Circuit Rating (Amperes)	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
157	173500	150 low water cut-off w/water column	39.7 (18.0)
157-MD	173600	157 w/maximum differential	39.7 (18.0)
157-A	173700	157 w/alternate tappings	39.5 (17.9)
157-A-M	173800	157-A w/manual reset	39.5 (17.9)
157-M	175400	157 w/manual reset	39.7 (18.0)
157-M-MD	175410	157-M w/maximum differential	39.7 (18.0)
157-R	176200	157 w/alternate tappings	42.0 (19.0)
157-R-M	177300	157-R w/manual reset	42.0 (19.0)
157-RBP-MD	176501	157 w/2 integral conductance probes	51.0 (23.1)
157-RL	176900	157 w/alternate tappings	42.0 (19.0)
157-RL-M	177000	157-RL w/manual reset	42.0 (19.0)

Dimensions, in. (mm)

Model	A NPT	B NPT	C	D	E	F	G	H	J	K NPT	L
157	1 (25)	1/2 (15)	13 9/16 (345)	2 5/8 (59)	4 15/16 (125)	11 3/4 (298)	16 (406)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	5 7/8 (149)
157-A	1 1/4 (32)	3/4 (20)	13 9/16 (345)	2 5/8 (59)	4 15/16 (125)	11 3/4 (298)	16 (406)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	5 7/8 (149)
157-R	1 (25)	1/2 (15)	13 9/16 (345)	2 1/4 (57)	5 7/8 (149)	11 3/4 (298)	17 (432)	11 1/2 (292)	3 1/2 (89)	3/4 (20)	6 1/4 (159)
157-RL	1 1/4 (32)	1/2 (15)	13 9/16 (345)	3 1/2 (89)	5 7/8 (149)	11 3/4 (298)	17 (432)	12 3/4 (324)	3 1/2 (89)	3/4 (20)	6 1/4 (159)
157-RBP-MD	1 (25)	1/2 (15)	13 9/16 (345)	2 1/4 (57)	5 7/8 (149)	11 3/4 (298)	17 (432)	11 1/2 (292)	3 1/2 (89)	N/A	12 3/4 (324)

BOILER CONTROLS

Water Feeders and Combination Water Feeders/Low Water Cut-Offs

McDonnell & Miller Boiler Water Feeders and Feeder Cut-Off Combinations are used to provide automatic operation, and to safeguard steam and hot water boilers against the hazards of a low water condition.

A feeder cut-off combination mechanically adds water as needed to maintain the required minimum water level, and electrically stops the firing device in case of an emergency.

How to Select Controls

STEAM BOILERS

Steam Heating Boilers are classified as boilers in closed heating systems where all condensate is returned to the boiler. Best recommendation for all automatically fired boilers is a feeder cut-off combination. It adds water as needed to maintain a safe operating level, and stands by to interrupt circuit to burner if water level drops into emergency zone.

Steam Process Boilers are classified as boilers in systems where not all the condensate is returned, and some make-up water is needed. A separate feeder and separate cut-off are recommended, so operating levels can be set for the wider differential required in such service.

Selection of the correct feeder cut-off combination, or feeder depends upon:

1. Maximum boiler pressure.
2. Differential between water supply pressure and the pressure setting of the steam safety valve.
3. Boiler size

See chart opposite page.

HOT WATER BOILERS

Best recommendation for all automatically fired boilers is a feeder cut-off combination. It adds water if needed to match the discharge capacity of the relief valve, and stands by to interrupt circuit to burner if water level drops into emergency zone.

Selection of the correct feeder cut-off combination, or feeder depends upon:

1. Maximum boiler pressure.
2. Differential between water supply pressure and the pressure setting of the safety relief valve.
3. Boiler size

See chart opposite page.

How to Select Water Feeders (continued)

Steam Boilers

Series	Characteristics	Maximum Boiler Pressure psi (kg/cm ²)	Boiler Size (Mfr. Gross Rating Sq. Ft. of EDR)						
			*Differential Pressure psi (kg/cm ²)						
			10 (.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.5)	60 (4.2)	70 (4.9)
Uni-Match®	For Automatic Fired Heating Boilers	15 (1.0)	All Boilers up to 2,000 sq. ft.						
101A	For Automatic Fired Heating Boilers	25 (1.8)	All Boilers up to 5,000 sq. ft.						
47	For Heating or Process Boilers	25 (1.8)	All Boilers up to 5,000 sq. ft.						
47-2	For Automatic Fired Heating Boilers	25 (1.8)	All Boilers up to 5,000 sq. ft.						
247	For Heating or Process Boilers	30 (2.1)	All Boilers up to 5,000 sq. ft.						
247-2	For Automatic Fired Heating Boilers	30 (2.1)	All Boilers up to 5,000 sq. ft.						
51	For Heating or Process Boilers	35 (2.5)	8,600	12,000	15,000	17,600	20,000	21,800	23,400
51-2	For Automatic Fired Heating Boilers	35 (2.5)	8,600	12,000	15,000	17,600	20,000	21,800	23,400
51S	For Heating or Process Boilers	35 (2.5)	10,500	17,500	22,400	26,500	30,000	32,600	35,000
51S-2	For Automatic Fired Heating Boilers	35 (2.5)	10,500	17,500	22,400	26,500	30,000	32,600	35,000
53	For Heating or Process Boilers	75 (5.3)	8,600	11,600	14,600	17,000	18,800	20,600	22,100
53-2	For Automatic Fired Heating Boilers	75 (5.3)	8,600	11,600	14,600	17,000	18,800	20,600	22,100

*Differential pressure should be based on water supply pressure at boiler, minus pressure setting of steam safety valve

Hot Water Boilers

Series	Characteristics	Maximum Boiler Pressure psi (kg/cm ²)	Boiler Size (Btu/hr. Output Capacity)				
			Calories				
			†Differential Pressure psi (kg/cm ²)				
			10 (.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.5)
Uni-Match®	For Automatic Fired Heating Boilers	15 (1.0) K-calories:	All Boilers up to 500,000 btu/hr. (1984)				
101A	For Automatic Fired Heating Boilers	25 (1.8) K-calories:	1,000,000 (4,000)	1,400,000 (5,500)	1,800,000 (7,100)	2,100,000 (8,300)	2,350,000 (9,300)
247 247-2	For Automatic Fired Heating Boilers	30 (2.1) K-calories:	1,000,000 (4,000)	1,400,000 (5,500)	1,800,000 (7,100)	2,100,000 (8,300)	2,350,000 (9,300)
51 51-2	For Automatic Fired Heating Boilers	35 (2.5) K-calories:	2,000,000 (7,900)	3,000,000 (11,900)	3,750,000 (14,900)	4,400,000 (17,400)	5,000,000 (19,800)
51-S	For Process Boilers	35 (2.5) K-calories:	2,800,000 (11,100)	4,300,000 (17,000)	5,600,000 (22,200)	6,700,000 (26,600)	7,500,000 (29,800)
51-S-2	For Automatic Fired Heating Boilers	35 (2.5) K-calories:	2,800,000 (11,100)	4,300,000 (17,000)	5,600,000 (22,200)	6,700,000 (26,600)	7,500,000 (29,800)
53 53-2	For Automatic Fired Heating Boilers	75 (5.3) K-calories:	2,100,000 (8,300)	2,800,000 (11,100)	3,300,000 (13,000)	4,200,000 (16,700)	4,750,000 (18,900)

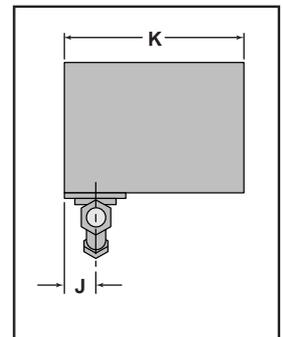
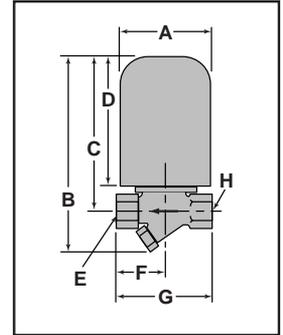
†Differential pressure should be based on water supply pressure at boiler, minus pressure setting of safety relief valve.

Water Feeders – Electric

Uni-Match® Electric Water Feeders



- For low pressure steam boilers (1,000,000 BTU/hr. max.)
- Three position slide switch allows the timing cycle to be matched to that of the major low water cut-off manufacturers
- Field adaptable feed rate – 1, 2, or 4 gpm (3.8, 7.6, or 15.1 lpm)
- Electronic operation provides consistent, accurate cycle-to-cycle repeatability
- Universal design simplifies selection and reduces stock
- Can be used with mechanical or electronic low water cut-off controls
- Manual feed button
- Includes $\frac{3}{8}$ " x $\frac{1}{2}$ " (9.5 x 12.7mm) sweat adapters for quick installation with $\frac{1}{2}$ " (13mm) copper tubing
- Easy to clean strainer
- Maximum water pressure 150 psi (10.5 kg/cm²)
- Maximum boiler pressure 15 psi (1 kg/cm²)
- Maximum water temperature 175°F (79°C)
- Maximum ambient temperature 100°F (38°C)
- Maximum power consumption (during water feed only)
 - 15 watts at 24 VAC
 - 20 watts at 120 VAC (50 or 60 Hz)



Dimensions, in. (mm)

A	B	C	D	E NPT	F	G	H NPT	J	K
2 ⁷ / ₈ (73)	6 ¹ / ₄ (159)	4 ⁷ / ₈ (124)	4 ¹ / ₄ (108)	3 ³ / ₈ (12)	1 ¹⁷ / ₃₂ (39)	3 ¹ / ₁₆ (78)	3 ³ / ₈ (12)	1 ¹ / ₃₂ (26)	5 ¹³ / ₁₆ (148)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
WF-2-U-24	169550	Electric Water Feeder, 24V	2.8 (1.3)
WF-2-U-120	169560	Electric Water Feeder, 120V	2.8 (1.3)

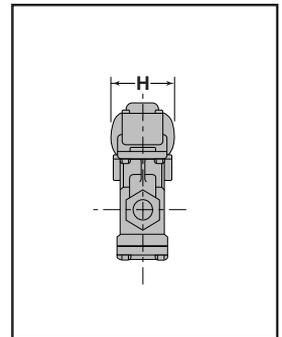
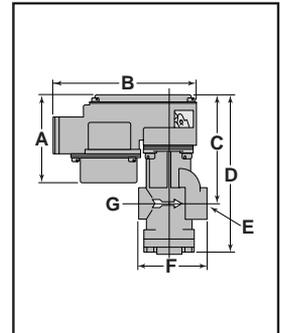
BOILER CONTROLS

Water Feeders – Electric (continued)

Series 101-A

Electric Water Feeders

- For low pressure steam boilers with **cold water feed**
- Eliminates necessity to manually add water to the boiler
- Can be used with mechanical or electronic low water cut-off controls
- Quick-change replaceable cartridge valve and strainer
- Manual feed button
- Model 101-A features a 120 VAC solenoid
- Model 101-A-24 features a 24 VAC solenoid and a separate 50VA transformer
- Maximum water pressure 150 psi (10.5 kg/cm²)
- Maximum boiler pressure 25 psi (1.8 kg/cm²)
- Maximum water temperature 175°F (79°C)
- Maximum power consumption
 - 40 watts at 24 VAC
 - 40 watts at 120 VAC



Flow Data

Pressure Differential psi (kg/cm ²)	Flow Rate gpm (lpm)
5 (.4)	1.4 (5.3)
10 (.7)	1.7 (6.4)
20 (1.4)	2.1 (7.9)
40 (2.8)	2.9 (11.0)
60 (4.2)	3.4 (12.9)
80 (5.6)	4.0 (15.1)

Dimensions, in. (mm)

A	B	C	D	E NPT	F	G NPT	H
4 ¹ / ₁₆ (103)	6 ⁷ / ₈ (175)	5 ¹ / ₈ (130)	7 ⁹ / ₁₆ (192)	1/2 (15)	3 ⁵ / ₁₆ (84)	1/2 (15)	3 (76)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
101A	169400	Electric water feeder, 120V	2.8 (1.3)
101A-24V	169500	Electric water feeder, 24V	2.8 (1.3)

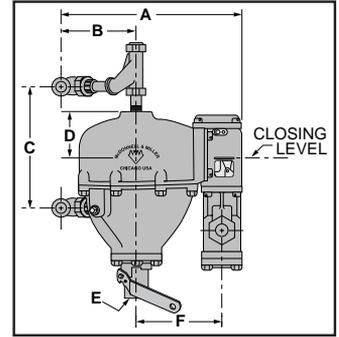
Water Feeders – Mechanical

Series 47 Mechanical Water Feeders

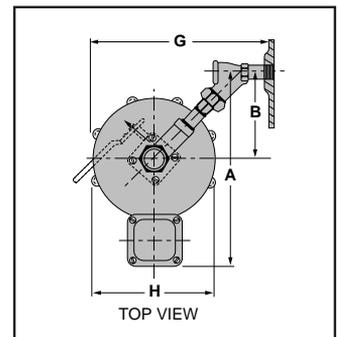
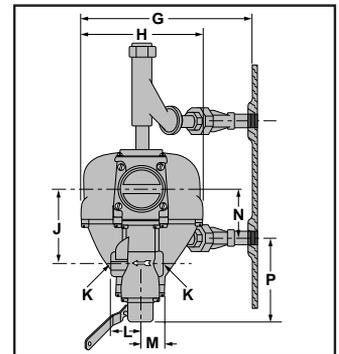
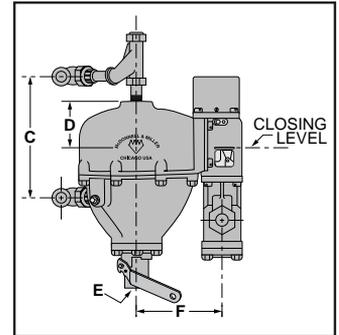
- For steam and hot water boilers with cold water feed
- Continuous maintenance of **minimum safe water level**, independent of electrical service
- Can be used with mechanical or electronic low water cut-off
- Proportional feed action
- Quick hook-up fittings provided
- Quick-change replaceable cartridge valve and strainer
- Quiet, durable operation
- Isolated feed valve minimizes lime and scale build-up
- Optional features
 - No. 2 switch
 - Manual reset
- Model 47 can be field upgraded with a No. 2 switch to add low water cut-off function
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum boiler pressure 25 psi (1.8 kg/cm²)



Series 47



Series 47-2



	CAUTION
	<p>Do not use Series 47 Water Feeders as operating controls. Failure to follow this caution could cause fire or flooding, and result in property damage or personal injury.</p>

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

Dimensions, in. (mm)

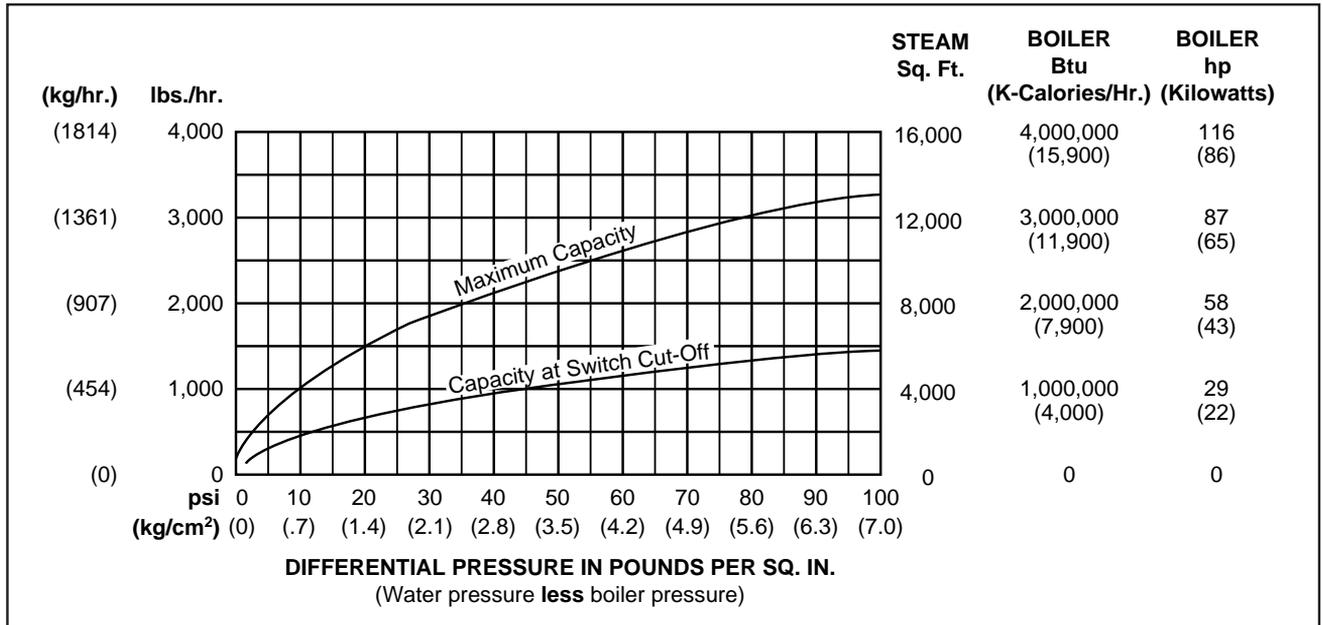
A	B	C	D	E NPT	F	G
11 ⁷ / ₈ (302)	5 ¹ / ₄ (133)	7 ³ / ₈ (187) min.	2 ⁵ / ₈ (67)	3 ³ / ₄ (20)	5 ¹ / ₈ (130)	10 ⁵ / ₈ (270)
H	J	K NPT	L	M	N	P
7 ⁵ / ₁₆ (186)	4 ⁵ / ₈ (117)	1 ¹ / ₂ (15)	1 ²⁹ / ₃₂ (58.4)	1 ¹³ / ₃₂ (35.7)	3 (76)	5 ⁵ / ₁₆ (135)

BOILER CONTROLS

Water Feeders – Mechanical (continued)

Series 47 (continued) Mechanical Water Feeders

Capacities



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
47	132700	Mechanical water feeder	27.5 (12.5)
47-2	132800	47 w/No. 2 switch	28.5 (13.0)
47-2-M	132900	47-2 w/manual reset	28.5 (13.0)

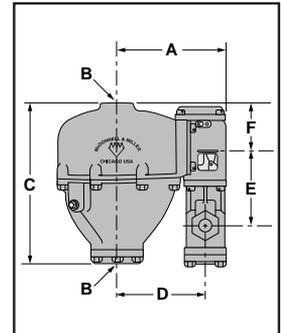
Water Feeders – Mechanical

Series 247 Mechanical Water Feeders

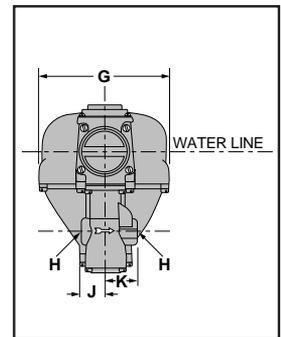
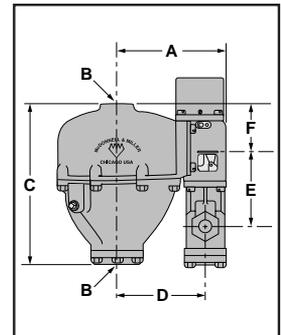
- For steam and hot water boilers with cold water feed
- Continuous maintenance of **minimum safe water level**, independent of electrical service
- Proportional feed action
- Quick-change replaceable cartridge valve and strainer
- Quiet, durable operation
- Isolated feed valve minimizes lime and scale build-up
- Optional features
 - No. 2 switch
 - Manual reset
- Model 247 can be field upgraded with a No. 2 switch to add low water cut-off function
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 30 psi (2.1 kg/cm²)



Series 247



Series 247-2



	CAUTION
	<p>Do not use Series 247 Water Feeders as operating controls. Failure to follow this caution could cause fire or flooding, and result in property damage or personal injury.</p>

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

Dimensions, in. (mm)

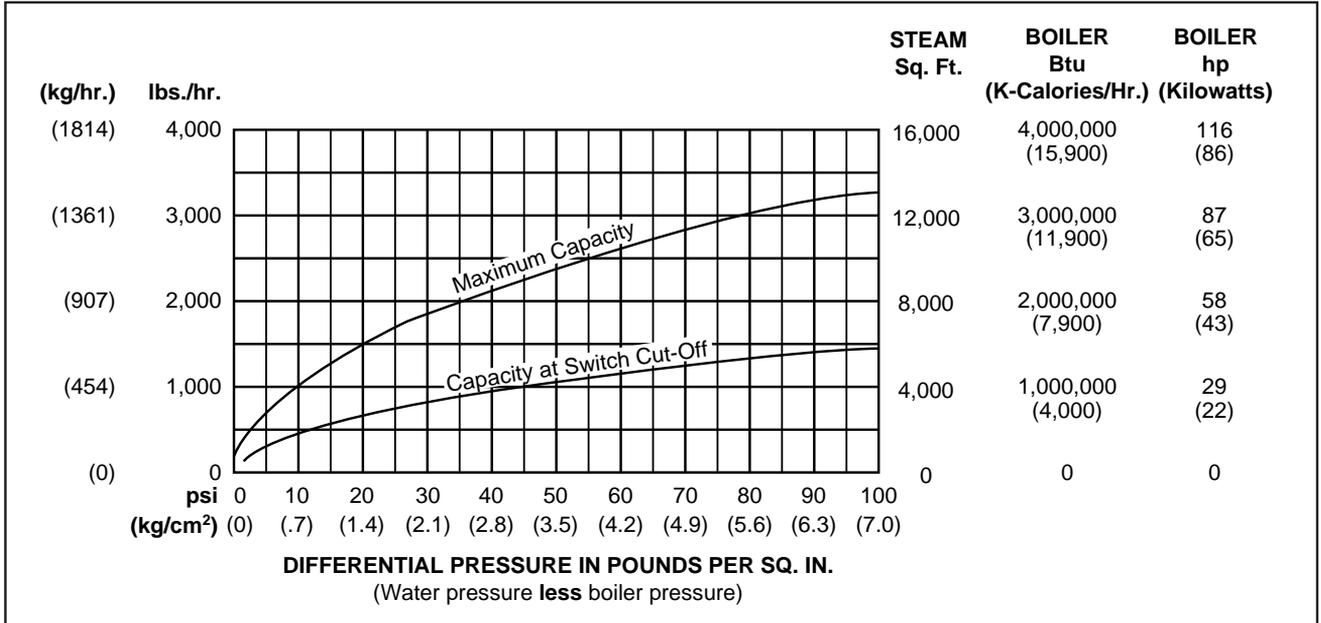
A	B NPT	C	D	E	F	G	H NPT	J	K
6½ (165)	1 (25)	9⅛ (232)	5⅛ (130)	4⅝ (117)	2⅝ (67)	7⅝ (186)	½ (15)	1⅜ (35.7)	1⅔ (48.4)

BOILER CONTROLS

Water Feeders – Mechanical (continued)

Series 247 (continued) Mechanical Water Feeders

Capacities



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
247	133700	Mechanical water feeder	22.0 (10.0)
247-2	133800	247 w/No. 2 switch	22.5 (10.2)
247-2-M	133900	247-2 w/manual reset	22.5 (10.2)

BOILER CONTROLS

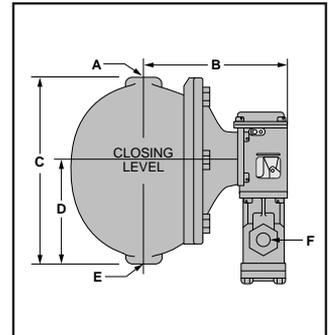
Water Feeders – Mechanical

Series 51 Mechanical Water Feeders

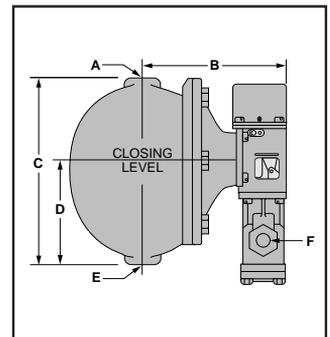
- For low pressure steam and hot water boilers larger than 5,000 sq. ft. (465m²) capacity with cold water feed
- Quick-change replaceable cartridge valve and strainer
- Optional features
 - No. 2 switch
 - Manual reset
 - Float block
- Proportional feed action
- Model 51 can be field upgraded with a No. 2 switch to add low water cut-off function
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)



Series 51



Series 51-2



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

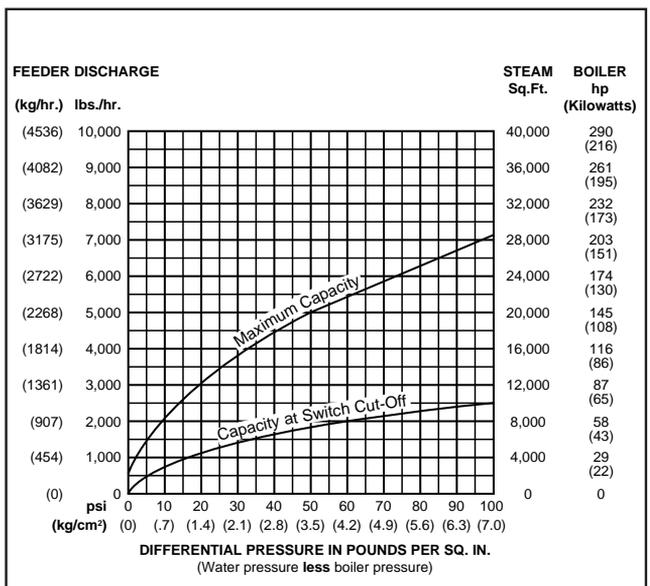
Dimensions, in. (mm)

A	B	C	D	E	F
NPT				NPT	NPT
1 (25)	8 (203)	10 ³ / ₈ (264)	5 ³ / ₄ (146)	1 (25)	³ / ₄ (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
51	134700	Mechanical water feeder	35.3 (16.0)
51-B	134800	51 w/float block	38.5 (17.5)
51-B-2	135400	51-B w/Series 2 switch	38.3 (17.4)
51-B-2-M	135500	51-B-2 w/manual reset	38.3 (17.4)
51-2	135000	51 w/Series 2 switch	35.8 (16.2)
51-2-M	135200	51-2 w/manual reset	35.7 (16.2)

Capacities



BOILER CONTROLS

Water Feeders – Mechanical (continued)

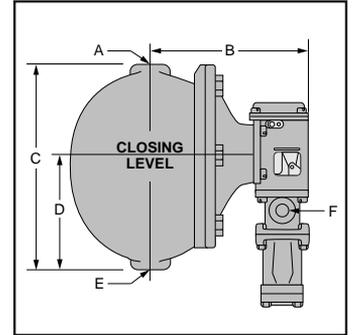
Series 51-S

Mechanical Water Feeders

- For high capacity [up to 35,000 sq. ft. (3250m²)] low pressure steam and hot water boilers with cold water feed
- Optional features
 - No. 2 switch
 - Manual reset
 - Float block
- Proportional feed action
- Maximum water supply pressure 100 psi (7 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)



Series 51-S



Electrical Ratings

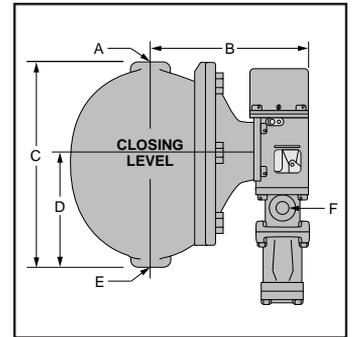
Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

Dimensions, in. (mm)

A	B	C	D	E	F
NPT				NPT	NPT
1 (25)	8 ¹ / ₈ (203)	10 ³ / ₈ (264)	5 ³ / ₄ (146)	1 (25)	3 ⁴ / ₄ (20)



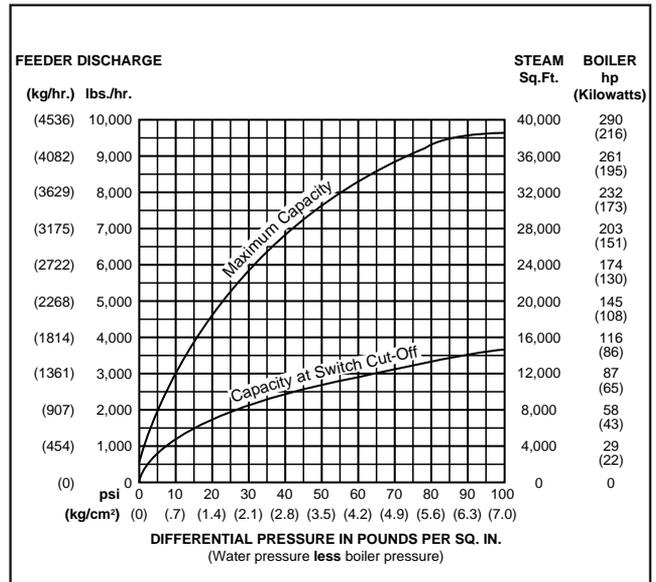
Series 51-S-2



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
51-S	135600	Mechanical water feeder	36.5 (16.6)
51-S-2	135900	51-S w/No. 2 switch	37.3 (16.9)
51-S-2-M	136000	51-S-2 w/manual reset	37.3 (16.9)
51-SB	135700	51-S w/float block	41.8 (19.0)
51-SB-2	136300	51-SB w/No. 2 switch	41.8 (19.0)
51-SB-2-M	136100	51-SB-2 w/manual reset	43.7 (19.8)

Capacities



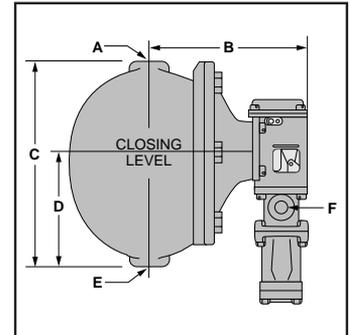
Water Feeders – Mechanical

Series 53 Mechanical Water Feeders

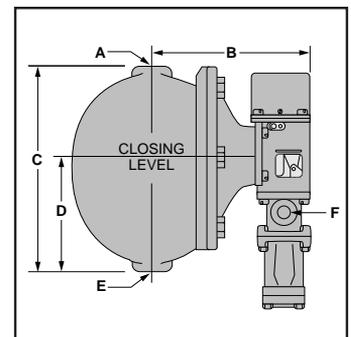
- For low pressure steam and hot water boilers larger than 5,000 sq. ft. (465m²) with hot or cold water feed
- Optional features
 - No. 2 switch
 - Manual reset
 - Float block
- Proportional feed action
- Model 53 can be field upgraded with a No. 2 switch to add low water cut-off function
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 75 psi (5.3 kg/cm²)



Series 53



Series 53-2



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

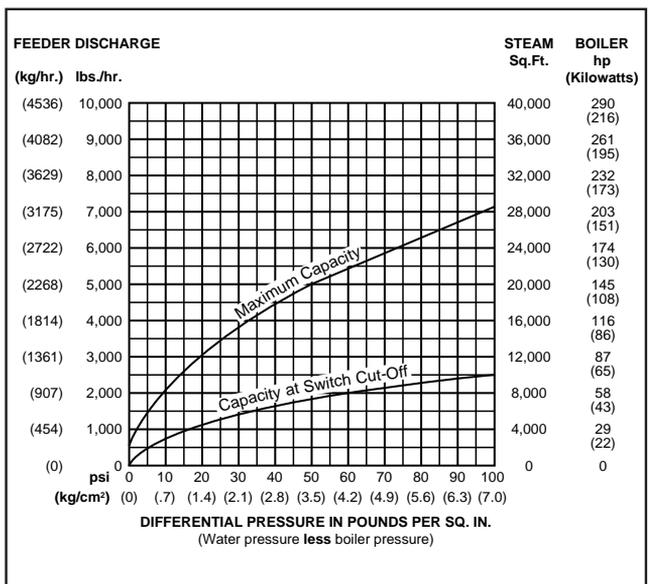
Dimensions, in. (mm)

A	B	C	D	E	F
NPT				NPT	NPT
1 (25)	8 ¹ / ₈ (206)	10 ³ / ₈ (264)	5 ³ / ₄ (146)	1 (25)	3 ³ / ₄ (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
53	136900	Mechanical water feeder	38.0 (17.2)
53-B	137400	53 w/float block	42.0 (19.0)
53-B-2-M	137600	53-B w/No. 2 switch & manual reset	42.0 (19.0)
53-2	137100	53 w/No. 2 switch	38.5 (17.5)
53-2-M	137200	53-2 w/manual reset	38.5 (17.5)

Capacities



BOILER CONTROLS

Make-Up Water Feeders

In boiler feed systems with higher pressures, a make-up feeder is usually provided on the condensate receiver. It adds water to the receiver when necessary so there is always an adequate supply for boiler demand.

ITT McDonnell & Miller Make-up feeders provide large feeding capacity. Unless otherwise stated, valves and seats are of stainless steel and protected by a large integral strainer. Positive alignment of the valve is assured by cam & roller, straight thrust action. These feeders can be used for many other liquid control applications such as:

- Pharmaceutical
- Laboratory
- Industrial
- Distillation equipment
- Receiver tanks
- Evaporative coolers
- Humidifiers
- Aquariums
- Steam baths
- Wet and dry hygrometers

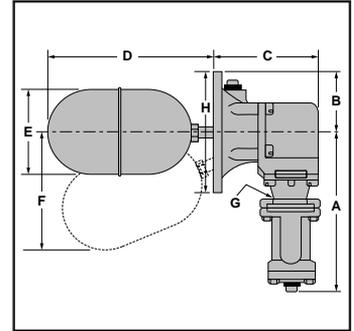
Water Feeding Capacity lbs./hr. (kg/hr.)

Model Number	City Water Supply Pressure with 1/8" (4mm) NPT Pipe and No Tank Pressure, 0 psi (kg/cm ²)								
	10 (.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.5)	60 (4.1)	70 (4.8)	80 (5.5)	90 (6.2)
25-A	3100 (1406)	4500 (2041)	5600 (2540)	6550 (2971)	7400 (3357)	8150 (3697)	8800 (3992)	9400 (4264)	10200 (4627)
21 & 221	4100 (1860)	6000 (2722)	7500 (3402)	8600 (3901)	9600 (4355)	10500 (4763)	11300 (5126)	12000 (5443)	13200 (5988)
847	1000 (454)	1500 (680)	1800 (816)	2100 (953)	2400 (1089)	2600 (1179)	2800 (1270)	3000 (1361)	3300 (1497)
851	2000 (907)	3000 (1361)	3700 (1678)	4300 (1850)	4800 (2177)	—	—	—	—
851-S	3000 (1361)	4000 (1814)	5000 (2268)	6200 (2812)	—	—	—	—	—
551-S	2500 (1134)	3600 (1633)	4500 (2041)	5200 (2359)	5800 (2631)	6500 (2948)	7000 (3175)	7600 (3447)	8800 (3992)

Water Feeders – Make-Up

Series 21 Make-Up Water Feeder

- For boiler receiver tanks
- Direct mounting eliminates need for equalizing connections
- Proportional feed action
- Mounting Flange – six 7/16" (11.1mm) bolt holes on a 5 3/4" (146mm) bolt circle
- Soft seat provides positive seal **NEW**
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)

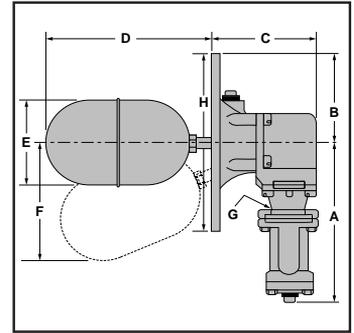


Dimensions, in. (mm)

A	B	C	D	E	F	G NPT	H
8 1/2 (216)	3 5/16 (84)	5 5/8 (143)	8 13/16 (224)	4 3/4 (121)	6 1/4 (159)	3/4 (20)	6 11/16 (170)

Series 221 Make-Up Water Feeder

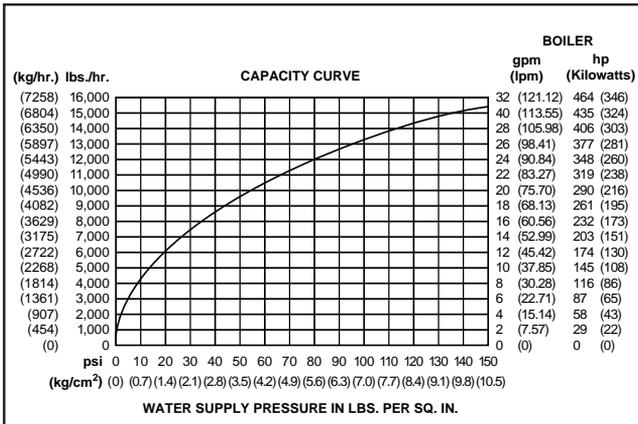
- For boiler receiver tanks
- Direct mounting eliminates need for equalizing connections
- Proportional feed action
- Mounting Flange – six 1 7/32" (13.5mm) bolt holes on a 8 1/2" (216mm) bolt circle
- Soft seat provides positive seal **NEW**
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)



Dimensions, in. (mm)

A	B	C	D	E	F	G NPT	H
8 1/2 (216)	4 11/16 (84)	5 5/8 (143)	8 13/16 (224)	4 3/4 (121)	6 1/4 (159)	3/4 (20)	9 1/2 (241)

Capacities



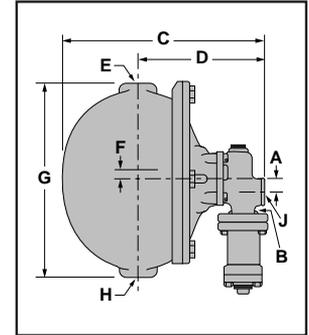
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
21	126400	Make-up water feeder	15.3 (6.9)
221	126600	Make-up water feeder	21.3 (9.7)

Water Feeders – Make-Up (continued)

Series 25-A Make-Up Water Feeder

- For boiler receiver tanks
- Float operated
- Proportional feed action
- Monel valve seat
- Seal between float chamber and valve chamber is not a positive seal
- Maximum water supply pressure 100 psi (7 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)



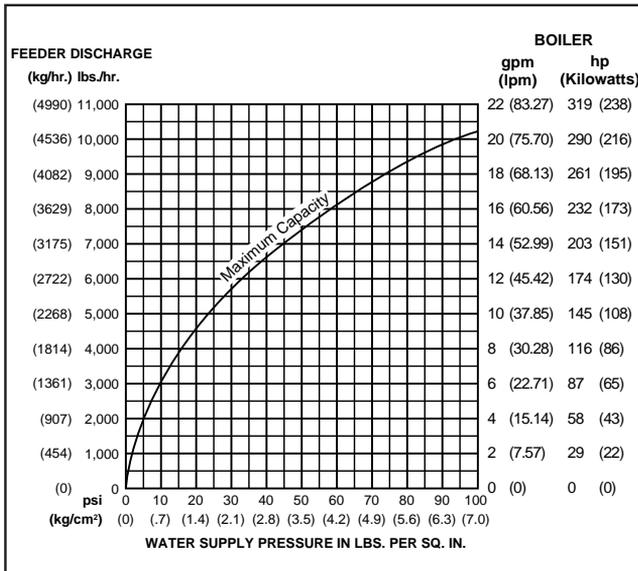
Dimensions, in. (mm)

A	B NPT	C	D	E NPT	F	G	H NPT	J NPT
1 ³ / ₁₆ (21)	3/4 (20)	12 ¹ / ₄ (311)	8 ⁷ / ₈ (206)	1 (25)	1/2 (12.7)	10 ³ / ₈ (264)	1 (25)	3/4 (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
25-A	126800	Make-up water feeder	37.5 (17)

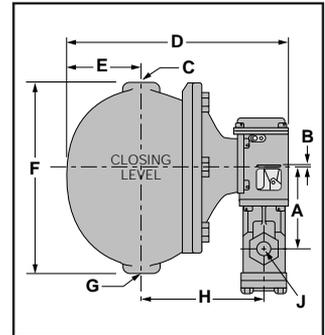
Capacities



Water Feeders – Make-Up

Series 551-S Make-Up Water Feeder

- For applications where water is added to steam separators, receivers, tanks, or other vessels
- Proportional feed action
- Quick-change replaceable cartridge valve and strainer
- Optional features
 - Float Block
- Maximum water supply pressure 75 psi (5.3 kg/cm²)
- Maximum pressure 25 psi (1.8 kg/cm²)



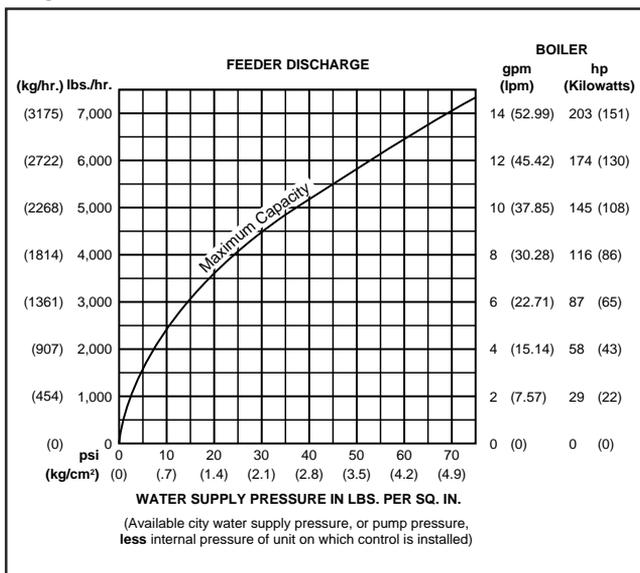
Dimensions, in. (mm)

A	B	C NPT	D	E	F	G NPT	H	J NPT
4 ⁵ / ₈ (117)	1 ¹ / ₈ (3.2)	1 (25)	12 ¹ / ₄ (311)	4 ¹ / ₈ (105)	10 ³ / ₈ (264)	1 (25)	6 ¹¹ / ₁₆ (170)	3 ³ / ₄ (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
551-S	136400	Make-up water feeder	35.8 (16.2)
551-SB	136500	551-S w/float block	35.8 (16.2)

Capacities

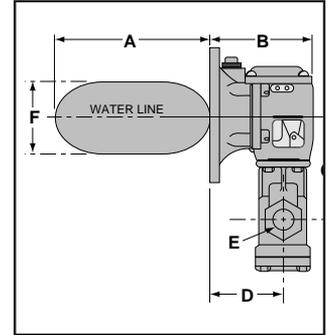


BOILER CONTROLS

Water Feeders – Make-Up (continued)

Series 847 Make-Up Water Feeder

- For receiver tanks in commercial or industrial applications
- Mounts directly on the receiver, eliminating need for equalizing connections
- Quick-change replaceable cartridge valve and strainer
- Proportional feed action
- Mounting Flange – six $\frac{7}{16}$ " (11.1mm) bolt holes on a $5\frac{3}{4}$ " (146mm) bolt circle
- Optional features
 - No. 2 switch
 - Alternate valve orientation
- Maximum supply pressure 150 psi (10.5 kg/cm²)
- Maximum receiver pressure 25 psi (1.8 kg/cm²)



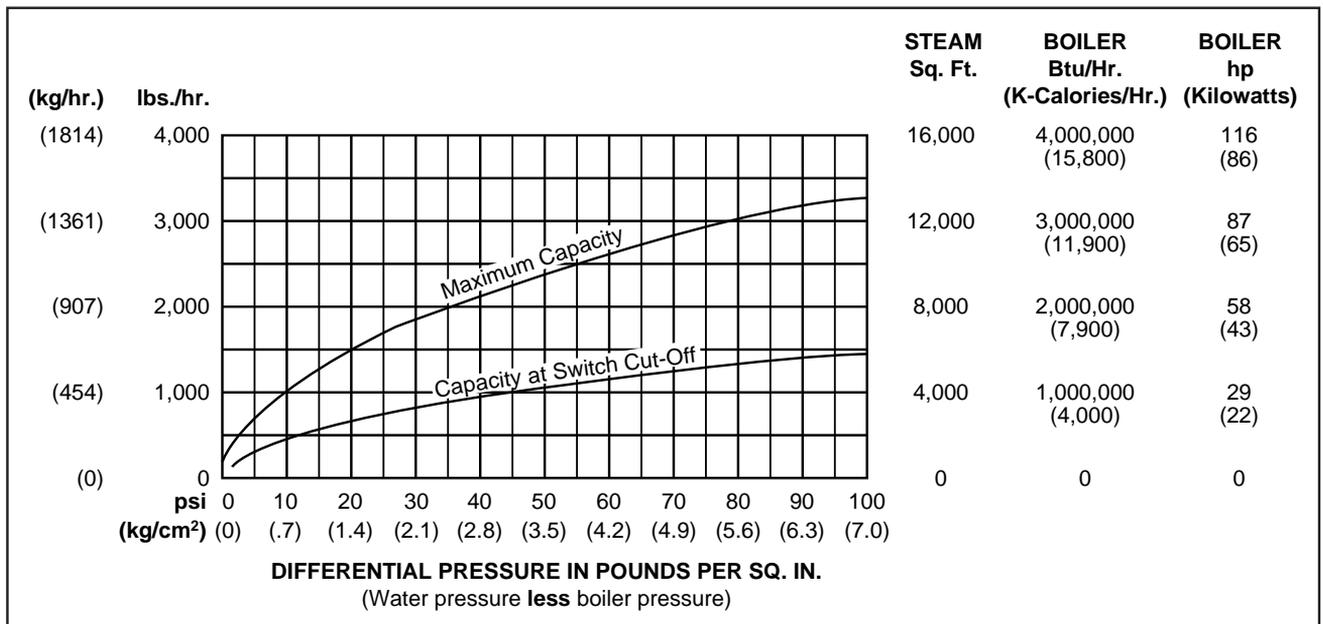
Dimensions, in. (mm)

A	B	C	D	E NPT	F
$7\frac{5}{16}$ (186)	$4\frac{15}{16}$ (125)	$4\frac{5}{8}$ (117)	$3\frac{9}{16}$ (90)	$\frac{1}{2}$ (15)	$3\frac{7}{16}$ (87)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
847	134300	Make-up water feeder	11 (5.0)
847-C	134350	847 w/alternate valve orientation	12 (5.4)
847-C-2	134400	847-C w/No. 2 switch	12 (5.4)

Capacities



BOILER CONTROLS

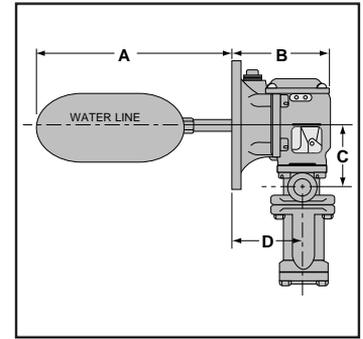
Water Feeders – Make-Up

Series 851 Make-Up Water Feeder

- For low pressure steam boilers and low or high pressure hot water boilers
- Mounts directly on the receiver, eliminating need for equalizing connections
- Quick-change replaceable cartridge valve and strainer
- Proportional feed action
- Mounting Flange – six 7/16" (11.1mm) bolt holes on a 5 3/4" (146mm) bolt circle
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum receiver pressure 35 psi (2.5 kg/cm²)



Series 851

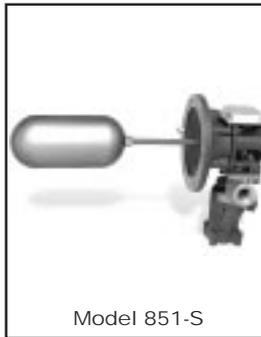


Dimensions, in. (mm)

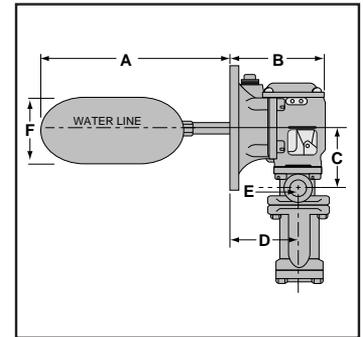
A	B	C	D	E NPT	F
11 3/4 (298)	4 15/16 (125)	4 5/8 (117)	3 9/16 (90)	3/4 (20)	3 7/16 (87)

Model 851-S Make-Up Water Feeder

- Extended float and rod assembly
- Wider operating range
- Maximum water supply pressure 100 psi (7 kg/cm²)
- Maximum receiver supply pressure 35 psi (2.5 kg/cm²)



Model 851-S



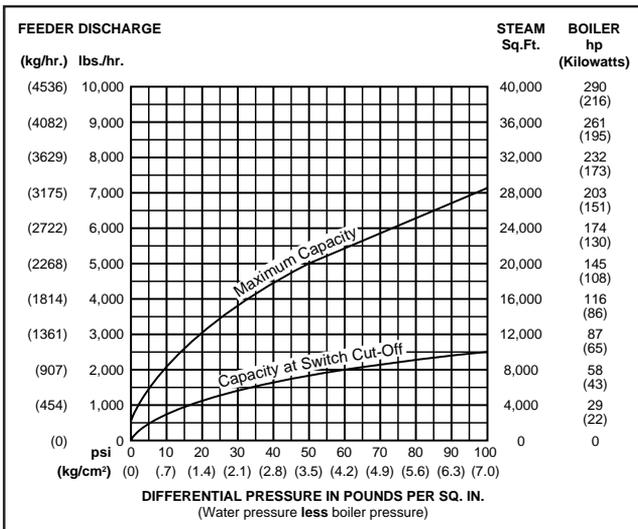
Dimensions, in. (mm)

A	B	C	D	E NPT	F
11 3/4 (298)	4 15/16 (125)	3 3/16 (81)	3 9/16 (90)	3/4 (20)	3 7/16 (87)

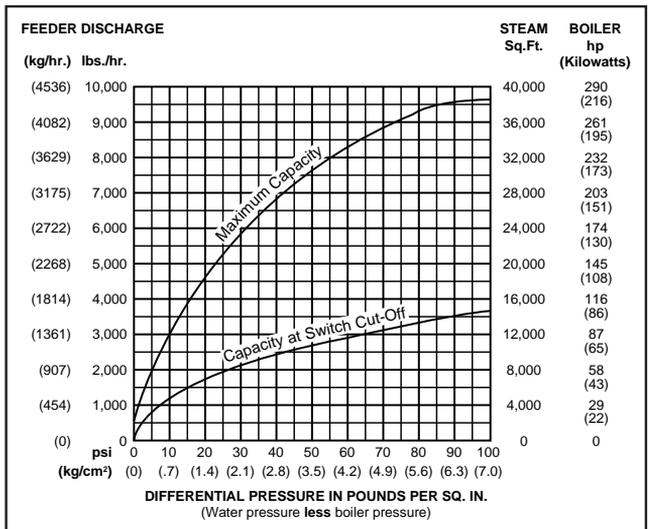
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
851	136700	Make-up water feeder	14 (6.4)
851-S	136800	851 w/extended float & rod assy.	16 (7.3)

Capacities – Model 851



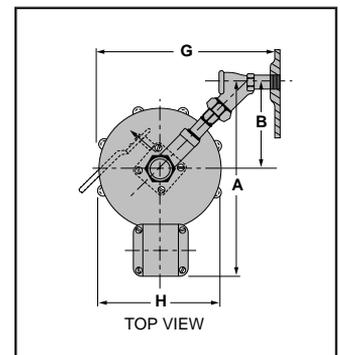
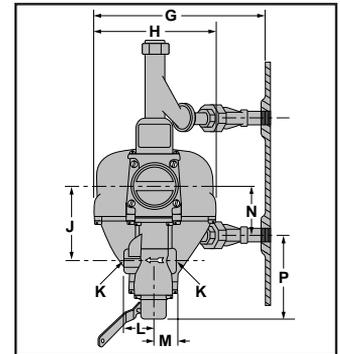
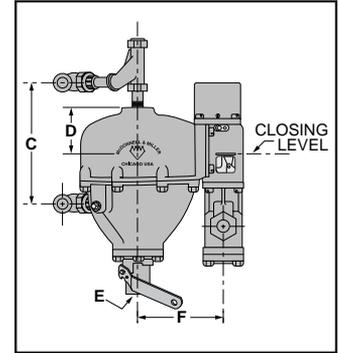
Capacities – Model 851-S



Combination Mechanical Water Feeder/ Low Water Cut-Offs (continued)

Series 47-2
Water Feeder/Low Water Cut-Off

- For steam and hot water boilers with cold water feed
- Continuous maintenance of **minimum safe water level**, independent of electrical service
- Proportional feed action
- No. 2 cut-off switch included
- Quick hook-up fittings provided
- Quick-change replaceable cartridge valve and strainer
- Quiet, durable operation
- Isolated feed valve minimizes lime and scale build-up
- Optional feature
 - Manual reset
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 25 psi (1.8 kg/cm²)



	CAUTION
	<p>Do not use Series 47-2 Water Feeder/ Low Water Cut-Offs as operating controls.</p> <p>Failure to follow this caution could cause fire or flooding, and result in property damage or personal injury.</p>

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

Dimensions, in. (mm)

A	B	C	D	E NPT	F	G
11 ⁷ / ₈ (302)	5 ¹ / ₄ (133)	7 ³ / ₈ (187) min.	2 ⁵ / ₈ (67)	3/4 (20)	5 ¹ / ₈ (130)	10 ⁵ / ₈ (270)
H	J	K NPT	L	M	N	P
7 ⁵ / ₁₆ (186)	4 ⁵ / ₈ (117)	1/2 (15)	1 ²⁹ / ₃₂ (58.4)	1 ¹³ / ₃₂ (35.7)	3 (76)	5 ⁵ / ₁₆ (135)

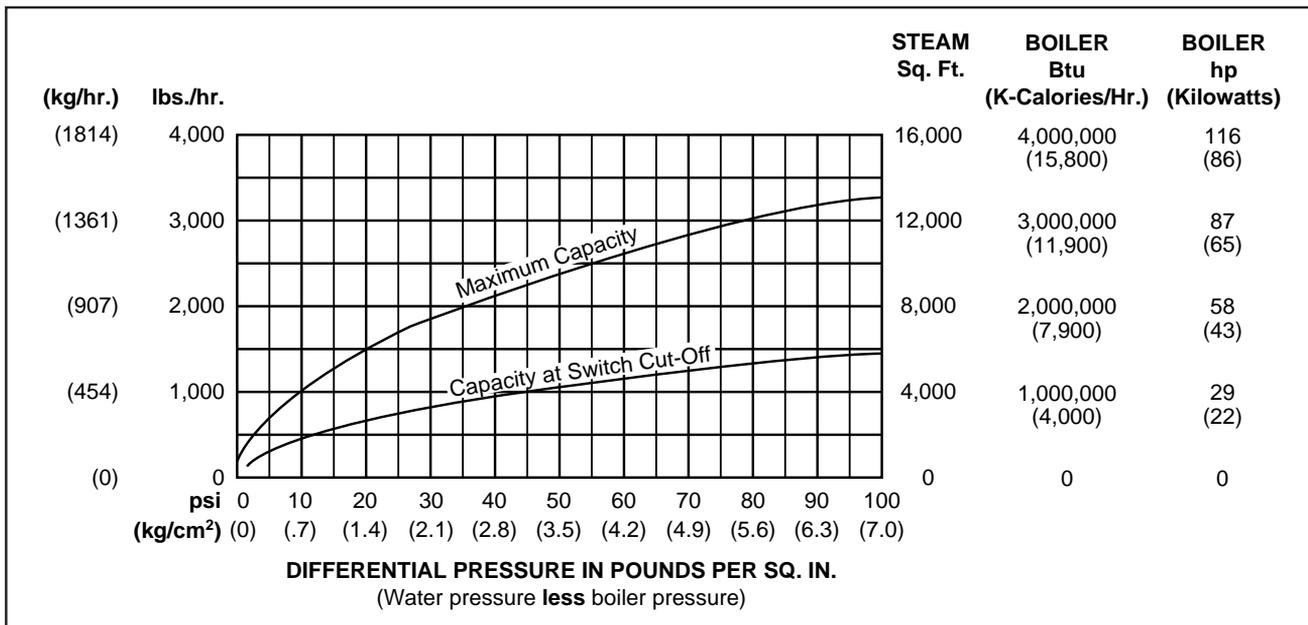
BOILER CONTROLS

Combination Mechanical Water Feeder/ Low Water Cut-Offs

Series 47-2(continued)

Water Feeder/Low Water Cut-Off

Capacities



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
47-2	132800	Mechanical water feeder w/No. 2 switch	28.5 (13.0)
47-2-M	132900	47-2 w/manual reset	28.5 (13.0)



Combination Mechanical Water Feeder/ Low Water Cut-Offs (continued)

Series 247-2

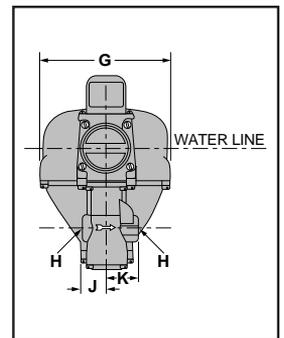
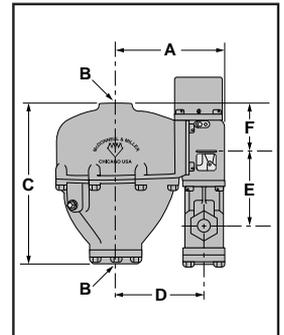


Mechanical Water Feeder/Low Water Cut-Off

- For steam and hot water boilers
- Continuous maintenance of **minimum safe water level**, independent of electrical service
- Proportional feed action
- No. 2 cut-off switch included
- Quick-change replaceable cartridge valve and strainer
- Quiet, durable operation
- Isolated feed valve minimizes lime and scale build-up
- Optional feature
 - Manual reset
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 30 psi (2.1 kg/cm²)



Series 247-2



 CAUTION	
	Do not use Series 247-2 Water Feeder/ Low Water Cut-Offs as operating controls.
	Failure to follow this caution could cause fire or flooding, and result in property damage or personal injury.

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

Dimensions, in. (mm)

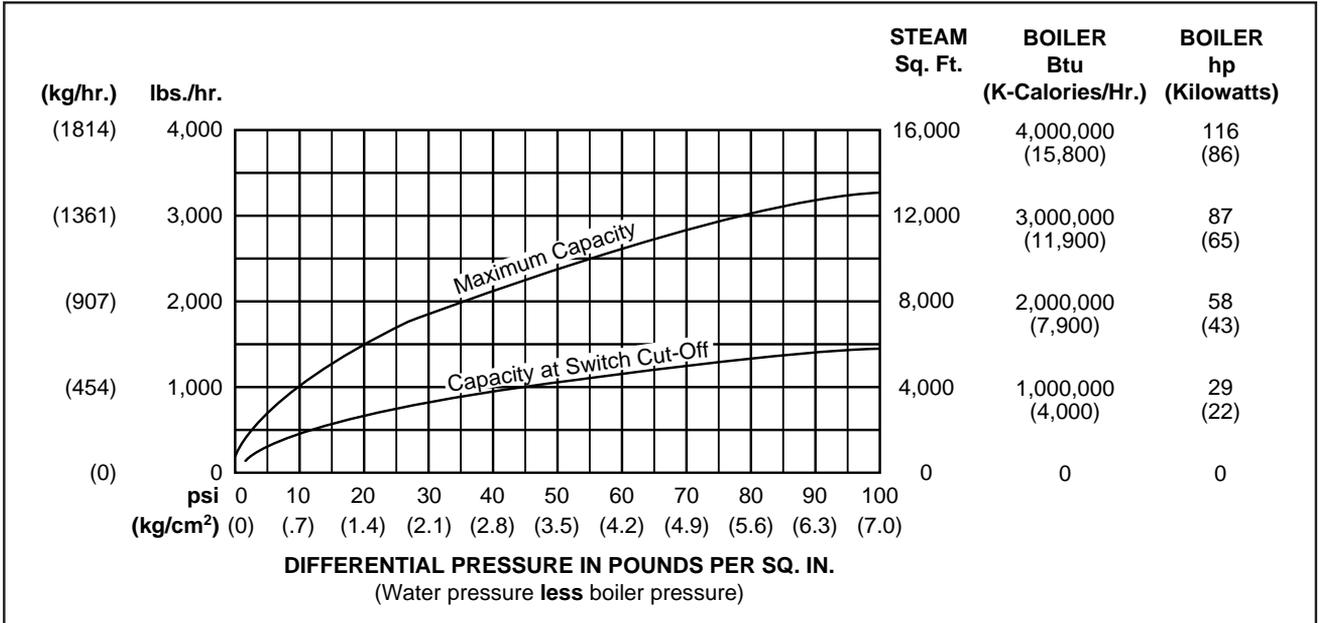
A	B NPT	C	D	E	F	G	H NPT	J	K
6½ (165)	1 (25)	9⅛ (232)	5⅛ (130)	4⅝ (117)	2⅝ (67)	7⅝ (186)	½ (15)	1⅓ (35.7)	1⅔ (48.4)

Combination Mechanical Water Feeder/ Low Water Cut-Offs (continued)

Series 247-2 (continued)

Mechanical Water Feeder/Low Water Cut-Off

Capacities



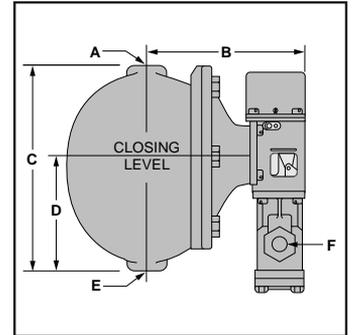
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
247-2	133800	Mechanical water feeder w/No. 2 switch	22.5 (10.2)
247-2-M	133900	247-2 w/manual reset	22.5 (10.2)

Combination Mechanical Water Feeder/ Low Water Cut-Offs

Series 51-2
Water Feeder/Low Water Cut-Off

- For low pressure steam and hot water boilers larger than 5,000 sq. ft. (465m²) capacity with **cold water feed**
- No. 2 cut-off switch included
- Optional features
 - Manual reset
 - Float block
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

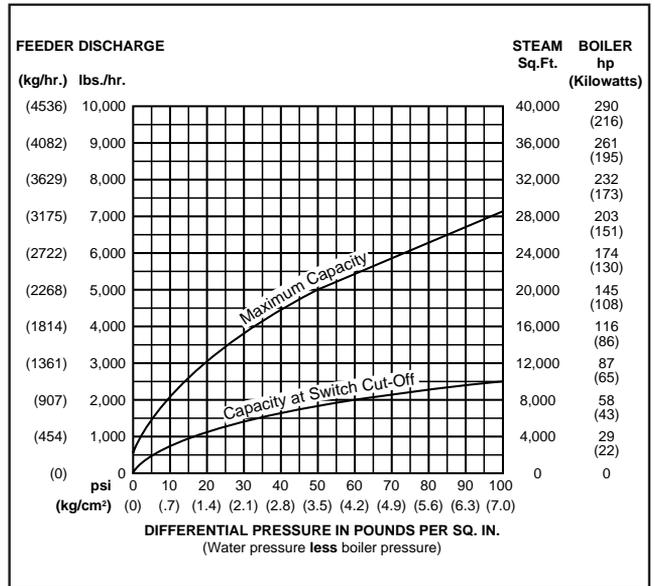
Dimensions, in. (mm)

A	B	C	D	E	F
NPT				NPT	NPT
1 (25)	8 ¹ / ₈ (206)	10 ³ / ₈ (264)	5 ³ / ₄ (146)	1 (25)	3 ⁴ / ₄ (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
51-2	135000	Mechanical water feeder w/No. 2 switch	35.8 (16.2)
51-2-M	135200	51-2 w/manual reset	35.7 (16.2)
51-B-2	133900	51-2 w/float block	38.3 (17.4)
51-B-2-M	135500	51-B-2 w/manual reset	38.3 (17.4)

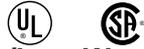
Capacities



BOILER CONTROLS

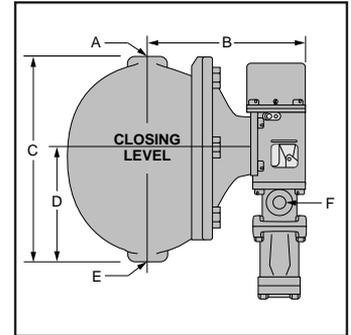
Combination Mechanical Water Feeder/ Low Water Cut-Offs (continued)

Series 51-S-2



Mechanical Water Feeder/Low Water Cut-Off

- For high capacity [up to 35,000 sq. ft. (3250m²)] low pressure steam and hot water boilers with **cold water feed**
- Integral strainer
- No. 2 cut-off switch included
- Optional features
 - Manual reset
 - Float block
- Maximum water supply pressure 100 psi (7 kg/cm²)
- Maximum pressure 35 psi (2.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

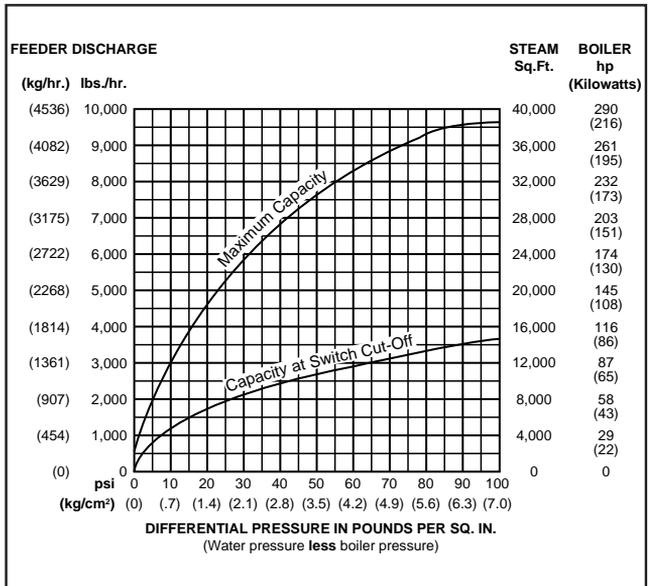
Dimensions, in. (mm)

A	B	C	D	E	F
NPT				NPT	NPT
1 (25)	8 ¹ / ₈ (206)	10 ³ / ₈ (264)	5 ³ / ₄ (146)	1 (25)	3 ¹ / ₄ (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
51-S-2	135900	Mechanical water feeder w/No. 2 switch	37.3 (16.9)
51-S-2-M	136000	51-S-2 w/manual reset	37.3 (16.9)
51-SB-2	136300	51-S w/float block & No. 2 switch	41.8 (19.0)
51-SB-2-M	136100	51-SB-2 w/manual reset	43.7 (19.8)

Capacities

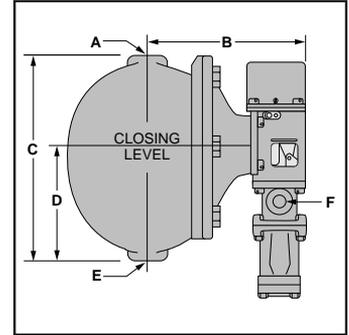


BOILER CONTROLS

Combination Mechanical Water Feeder/ Low Water Cut-Offs

Series 53-2 Mechanical Water Feeder/Low Water Cut-Off

- For low pressure steam and hot water boilers larger than 5,000 sq. ft. (465m²) with hot or cold water feed
- Integral strainer
- No. 2 cut-off switch included
- Optional features
 - Manual reset
 - Float block
- Maximum water supply pressure 150 psi (10.5 kg/cm²)
- Maximum pressure 75 psi (5.3 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	

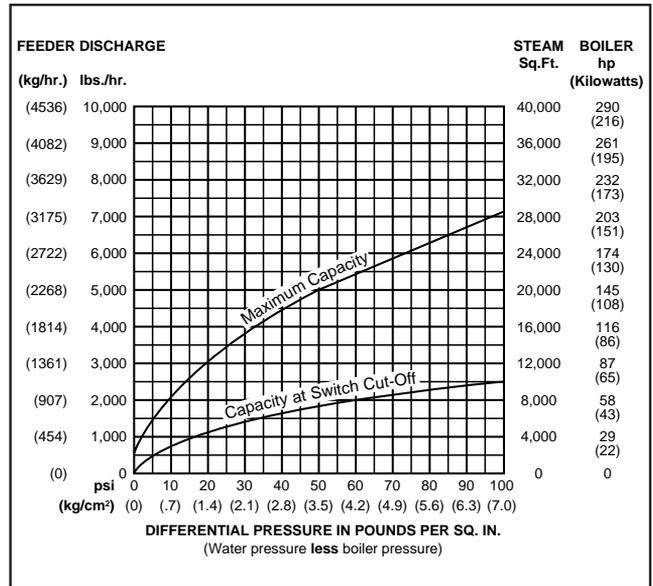
Dimensions, in. (mm)

A	B	C	D	E	F
NPT				NPT	NPT
1 (25)	8 1/8 (206)	10 3/8 (264)	5 3/4 (146)	1 (25)	3/4 (20)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
53-2	137100	Mechanical water feeder w/No. 2 switch	38.5 (17.5)
53-2-M	137200	53-2 w/manual reset	38.5 (17.5)
53-B-2-M	137600	53-2-M w/float block	42.0 (19.0)

Capacities



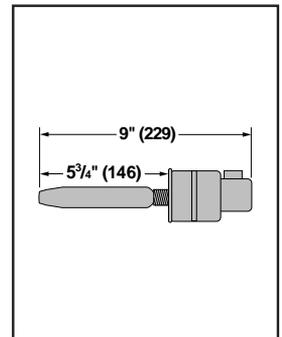
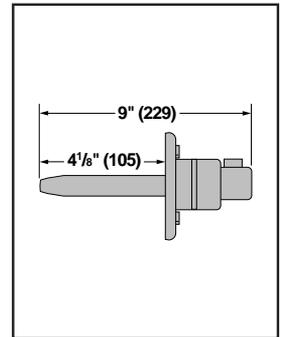
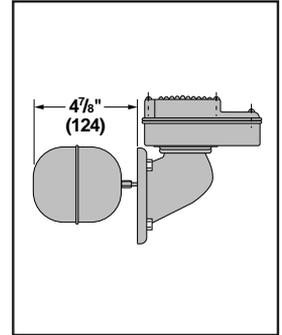
BOILER CONTROLS

Replacement Head Mechanisms For Low Water Cut-Offs and Water Feeders

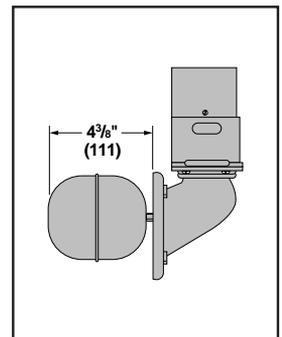
- Available for most McDonnell & Miller mechanical boiler controls
- Can be installed without disturbing existing equalizing connections or disassembly of components, making repair simple and easy
- Gaskets included

Low Water Cut-Offs

For Series	Repl. Head Model No.	Part Number	Description	Weight lbs. (kg)
42	42-HD	129500	Head mechanism	7.5 (3.4)
61	61-HD	140300	Head mechanism	3.5 (1.6)
	or 6667	153825	Head mechanism	1.5 (.7)



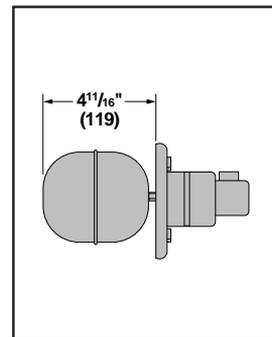
63	63-HD	142600	Head mechanism w/No. 2 switch	7 (3.2)
	or 63-M-HD	143200	63-HD w/manual reset	7 (3.2)



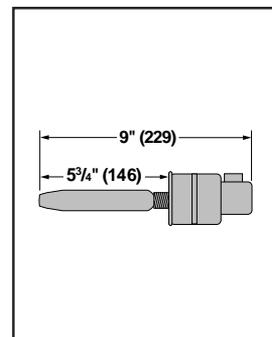
Replacement Head Mechanisms For Low Water Cut-Offs and Water Feeders (continued)

Low Water Cut-Offs (continued)

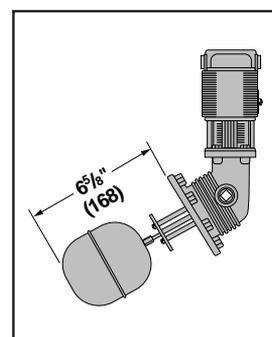
For Series	Repl. Head Model No.	Part Number	Description	Weight lbs. (kg)
64 764	64-HD	144400	Head mechanism	4 (1.8)



67 69 70 767	6667	153825	Head mechanism	1.5 (.7)
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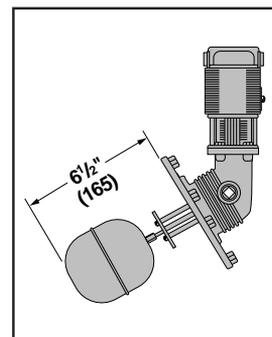


67-G	6667-MV	153850	Head mechanism	1.5 (.7)
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93 193	93-HD	162400	Head mechanism w/No. 5 switch	15 (6.8)
	93-M-HD	162600	93-HD w/manual reset	16 (7.3)

94 194	94-HD	165300	Head mechanism w/No. 5 switch	19.3 (8.8)
	94-M-HD	166000	94-HD w/manual reset	20.7 (9.4)

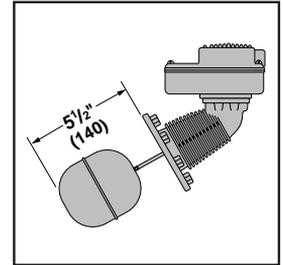


Low Water Cut-Offs (continued)

For Series	Repl. Head Model No.	Part Number	Description	Weight lbs. (kg)
150 150S	150-HD or	173000	Head mechanism w/ mercury switch	10.5 (4.8)
157 157S	150S-HD or	173003	Head mechanism w/ snap switch	11.0 (5.4)
	150-M-HD or	173200	150-HD w/manual reset	12.0 (5.4)
	150S-M-HD	173203	150S-HD w/manual reset	11.0 (5.0)
150-MD 157-MD	150-MD-HD or	173100	150-HD w/ maximum differential	11.0 (5.0)
157-RBP-MD 150S-MD	150S-MD-HD or	173103	150S-HD w/ maximum differential	11.0 (5.0)
157S-MD 157S-RBP-MD	150-M-MD-HD or	173300	150-HD w/manual reset & maximum differential	11.0 (5.0)
	150S-M-MD-HD	173302	150S-HD w/manual reset & maximum differential	11.0 (5.0)
	158-HD or	178600	Head mechanism w/ mercury switch	12.5 (5.7)
158 158S	158S-HD or	178602	Head mechanism w/ snap switch	12.5 (5.7)
	158-M-HD or	178700	158-HD w/manual reset	12.5 (5.7)
	158S-M-HD	178702	158S-HD w/manual reset	12.5 (5.7)
159 159S	159-HD or	178900	Head mechanism w/ mercury switch	12.0 (5.4)
	159S-HD	178902	Head mechanism w/ snap switch	12.0 (5.4)

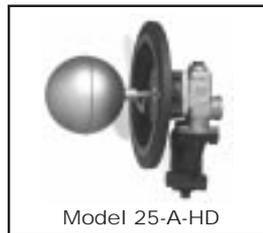


Model 150-HD & Model 150S-HD

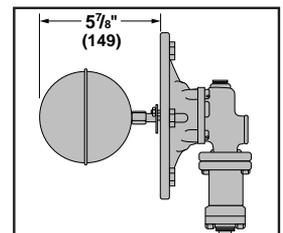


Water Feeders

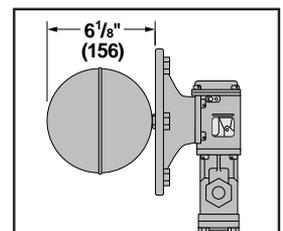
For Series	Repl. Head Model No.	Part Number	Description	Weight lbs. (kg)
25-A	25-A-HD	127100	Head mechanism	20 (9.1)
51	51-HD or	134900	Head mechanism	17 (7.9)
	51-2-HD	135100	51-HD w/No. 2 switch	18.3 (8.3)



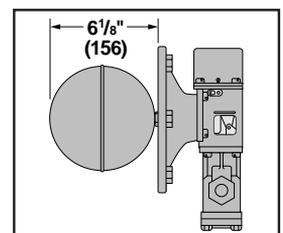
Model 25-A-HD



Model 51-HD



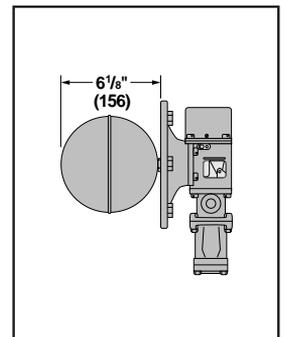
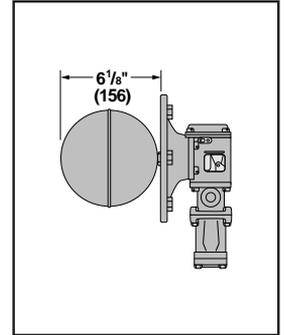
Model 51-2-HD



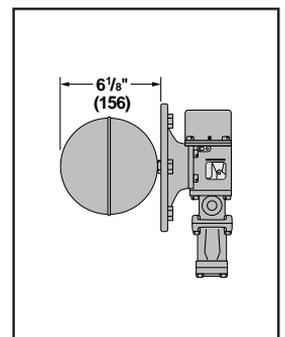
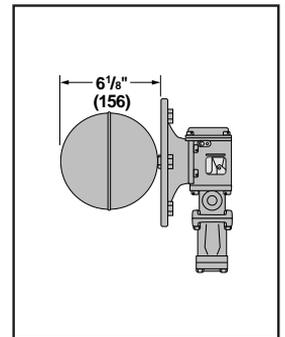
BOILER CONTROLS

Water Feeders (continued)

For Series	Repl. Head Model No.	Part Number	Description	Weight lbs. (kg)
51-S	51-S-HD	135800	Head mechanism	19 (8.6)
	51-S-2-HD	136200	51-S-HD w/No. 2 switch	20.5 (9.3)



53	53-HD	137000	Head mechanism	19.8 (9.0)
	53-2-HD	137300	53-HD w/No. 2 switch	20.5 (9.3)



Switches

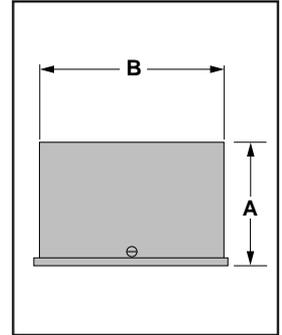
No. 2 Switches



- For Series 47, 247, 51, 51-S, 53, 63 and 847 Water Feeders to add low water cut-off function
- Provides flexibility for selection of functions desired
- Optional feature
 - Manual reset

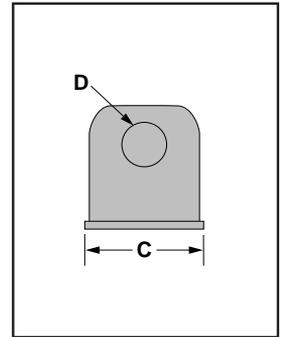
Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at 120 or 240 VAC 60 Hz
240 VAC	5.1	30.6	



Dimensions, in. (mm)

A	B	C	D
2½ (64)	3⅛ (79)	3¼ (83)	7⁄8 (22)



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
2	110000	Low water cut-off switch	1 (.5)
2-M	110100	No. 2 w/manual reset	1 (.5)

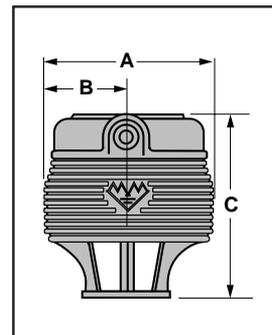
BOILER CONTROLS

Switches

No. 5 Switches



- For Series 93, 193, 94 and 194 Combination Low Water Cut-Off/Pump Controllers for steam boilers
- 2 Single pole, double break switches provided for operation at 2 different levels
- Provides flexibility for selection of functions such as alarm actuation, valve actuation control, or low water cut-off control
- Optional feature
– Manual reset



Electrical Ratings

345 VA at 120 or 240 VAC. Use copper wire only.

Dimensions, in. (mm)

A	B	C
6 (152)	3 (76)	6 ⁷ / ₁₆ (164)

Ordering Information

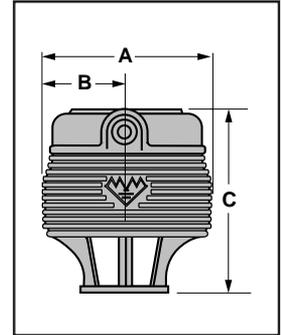
Model Number	Part Number	Description	Weight lbs. (kg)
5	110300	Electric switch	3.5 (1.6)
5-M	110400	No. 5 w/manual reset	3.5 (1.6)

Switches

No. 7-B Switches



- For Series 93, 193, 94 and 194 Combination Low Water Cut-Off/Pump Controllers for steam boilers
- 1 Single pole, double break switch provided for low water cut-off or alarm actuation
- Proportional signal controls a proportioning valve to maintain a constant water line
- Provides flexibility for selection of functions such as alarm actuation, valve actuation control, or low water cut-off control
- Optional feature – Manual reset



Electrical Ratings

345 VA at 120 or 240 VAC. Use copper wire only.

Potentiometer Slide Wire
24 VAC at 135 ohms

Dimensions, in. (mm)

A	B	C
6 (152)	3 (76)	6 ⁷ / ₁₆ (164)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
7B	110800	Electric switch/proportioning control	4 (1.8)
7B-M	110900	7B w/manual reset	4 (1.8)

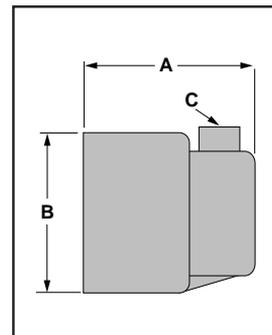
BOILER CONTROLS

Switches (continued)

No. 11 Switches



- For Series 61, 64, 67, 69, 70, 764 and 767 Low Water Cut-Off switch replacement
- 2 Single pole, single throw switches provided to control the water feeder and the low water cut-off
- No. 11 and 11-M are interchangeable
- Optional features
 - Manual reset
 - Millivolt service



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C
3 ³ / ₁₆ (81)	2 ³ / ₄ (70)	1/2 (15)

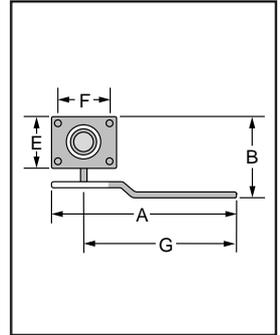
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
11	309100	Electric switch	0.5 (.23)
11-M	309151	No. 11 w/manual reset	0.5 (.23)
11-MV	309200	No. 11 w/Millivolt service	0.5 (.23)

Valves

Series 14-B Ball Type Blow Down Valve

- For McDonnell & Miller Series 47, 67 and 70 boiler control blow down valve replacement
- Full-ported ball action valve
- Teflon® seats provide bind free, leak tight ball movement
- Easy open handle keeps hands away from hot water and steam
- Gasket and mounting screws included
- Maximum pressure 30 psi (1.8 kg/cm²)

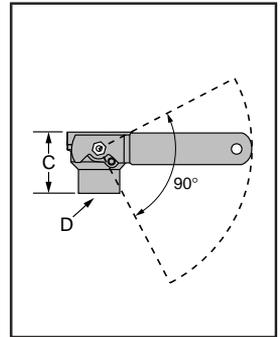


Dimensions, in. (mm)

A	B	C	D NPT	E	F	G
6 ³ / ₄ (171.4)	4 (102)	2 ¹ / ₄ (57)	³ / ₄ (20)	2 ³ / ₈ (60)	2 ¹ / ₂ (64)	5 ³ / ₄ (146)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
14-B	310447	Blow down valve	1 (.5)



BOILER CONTROLS

Valves (continued)

Cartridge Valve and Strainer Assembly Kit

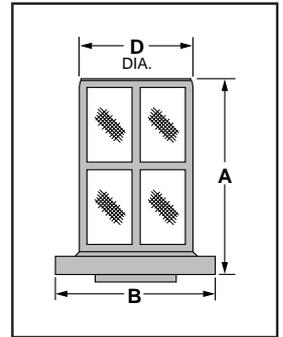
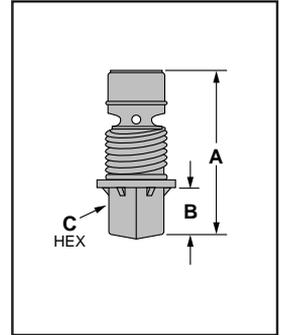
- For McDonnell & Miller Series 101-A, 47, 247, 847, 51, 551-S and 851 water feeders with **hex-shaped ports**
- Easy 2-minute in-line changeout saves time and money
- Noryl® resin valve is impervious to corrosion and provides longer life

Dimensions, in. (mm)

Product	A	B	C	D
Cartridge	2 ³ / ₈ (60)	5 ⁵ / ₈ (16)	1 ³ / ₁₆ (21)	-
Strainer	3 ¹ / ₈ (79)	2 ³ / ₈ (60)	-	1 ¹ / ₂ (38)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
CTR-51	310452	Cartridge & Strainer Kit for Series 51, 551-S and 851 water feeders (gray)	.8 (.36)
CTR-101	310453	Cartridge & Strainer Kit for Series 101-A, 47, 247, 847 water feeders (black)	.8 (.36)



Valves

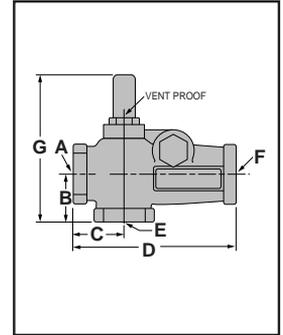
Series TC-4 Test-N-Check® Valves



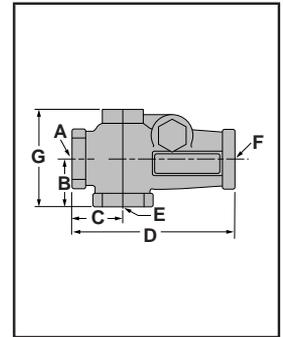
- For hot water boilers
- Simplifies ASME CSD-1a. code mandated testing of low water cut-offs by eliminating the need to drain the system
- Includes one upper and one lower valve for mounting at crosses in equalizing lines
- Restricts water flow when the low water cut-off's blow down valve is open
- Adjustable built-in vacuum breaker in upper valve provides rapid evacuation of water from the float chamber
- 1" (25mm) NPT
- Maximum temperature 250°F (121°C)
- Maximum pressure 160 psi (11 kg/cm²)



Series TC-4 Upper Valve



Series TC-4 Lower Valve



Dimensions, in. (mm)

A NPT	B	C	D
1 (25)	1½ (38)	1½ (38)	5 (125)
E NPT	F NPT	G	
		Upper	Lower
1 (25)	1 (25)	5¼ (133)	3⅞ (78)

Ordering Information

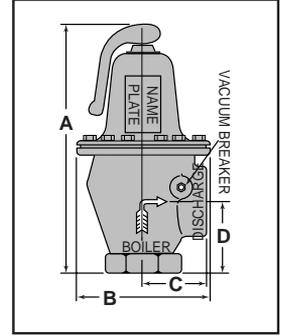
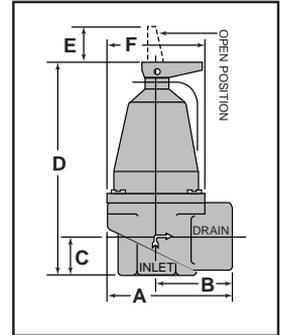
Model Number	Part Number	Description	Weight lbs. (kg)
TC-4	195000	Test-N-Check Valves, set of 2	5.3 (.4)

BOILER CONTROLS

Valves (continued)

Series 250 Pressure Relief Valves

- For tanks and hydronic heating systems
- Protects against over-pressure
- Minimizes hammering with flash steam
- Low differential pressure – 3 psi (.21 kg/cm²) between opening and closing
- Meets ASME Pressure Vessel and Boiler Code, Section IV
- Sizes and material
 - 3/4" - 1" (20 - 25mm) NPT – bronze body and seat
 - 2" (50mm) NPT – cast iron body, brass seat
- EPDM rubber diaphragm and seat disc
- Maximum temperature 250°F (121°C)
- Maximum operating pressure range 30 - 125 psig (2.1 - 8.8 kg/cm²)



Dimensions, in. (mm)

Size NPT	A	B	C	D	E	F
3/4 (20)	2 ⁹ / ₁₆ (65)	1 ¹ / ₂ (38)	3/4 (20)	4 ⁹ / ₁₆ (116)	1 ¹ / ₃₂ (26)	2 ³ / ₃₂ (53.2)
1 (25)	2 ⁷ / ₈ (73)	1 ³ / ₄ (45)	7/8 (22)	4 ¹⁵ / ₁₆ (125)	1 ¹ / ₃₂ (26)	2 ¹ / ₄ (57)
2 (50)	6 (152)	2 ⁷ / ₈ (73)	3 ¹ / ₄ (83)	11 (279)	—	—

Series 250
Pressure Relief Valves

Performance

Model Number	Opening Pressure psig (kg/cm ²)	ASME Rating BTUH (K-Calories)
250-3/4IN-15	15 (1)	515,000 (2,043)
250-3/4IN-30	30 (2.1)	790,000 (3,134)
250-3/4IN-36	36 (2.5)	900,000 (3,571)
250-3/4IN-40	40 (2.8)	973,000 (3,861)
250-3/4IN-45	45 (3.2)	1,065,000 (4,226)
250-3/4IN-50	50 (3.5)	1,160,000 (4,603)
250-3/4IN-60	60 (4.2)	1,252,000 (4,968)
250-3/4IN-75	75 (5.3)	1,615,000 (6,409)
250-3/4IN-100	100 (7)	2,075,000 (8,234)
250-3/4IN-125	125 (8.8)	2,535,000 (11,059)
250-1IN-15	15 (1)	770,000 (3,056)
250-1IN-30	30 (2.1)	1,170,000 (4,642)
250-1IN-36	36 (2.5)	1,330,000 (5,278)
250-1IN-40	40 (2.8)	1,437,000 (5,702)
250-1IN-45	45 (3.2)	1,575,000 (6,250)
250-1IN-50	50 (3.5)	1,710,000 (6,786)
250-1IN-65	65 (4.6)	2,110,000 (8,373)
250-1IN-75	75 (5.3)	2,385,000 (9,464)
250-1IN-100	100 (7)	3,060,000 (12,142)
250-1IN-125	125 (8.8)	3,735,000 (14,821)
250-2IN-30	30 (2.1)	4,100,000 (16,270)
250-2IN-36	36 (2.5)	4,600,000 (18,254)
250-2IN-40	40 (2.8)	5,000,000 (19,841)
250-2IN-45	45 (3.2)	5,500,000 (21,825)
250-2IN-50	50 (3.5)	5,900,000 (23,412)

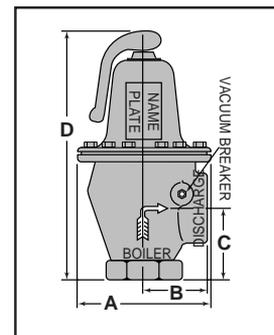
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
250-3/4IN-15	181220	Relief Valve 3/4 (20mm) NPT, 15 psi (1 kg/cm ²)	1.3 (.6)
250-3/4IN-30	181225	Relief Valve 3/4 (20mm) NPT, 30 psi (2.1 kg/cm ²)	1.3 (.6)
250-3/4IN-36	181325	Relief Valve 3/4 (20mm) NPT, 36 psi (2.5 kg/cm ²)	1.3 (.6)
250-3/4IN-40	181405	Relief Valve 3/4 (20mm) NPT, 40 psi (2.8 kg/cm ²)	1.3 (.6)
250-3/4IN-45	181425	Relief Valve 3/4 (20mm) NPT, 45 psi (3.2 kg/cm ²)	1.3 (.6)
250-3/4IN-50	181525	Relief Valve 3/4 (20mm) NPT, 50 psi (3.5 kg/cm ²)	1.3 (.6)
250-3/4IN-60	181905	Relief Valve 3/4 (20mm) NPT, 60 psi (4.2 kg/cm ²)	1.3 (.6)
250-3/4IN-75	181625	Relief Valve 3/4 (20mm) NPT, 75 psi (5.3 kg/cm ²)	1.3 (.6)
250-3/4IN-100	181725	Relief Valve 3/4 (20mm) NPT, 100 psi (7 kg/cm ²)	1.3 (.6)
250-3/4IN-125	181825	Relief Valve 3/4 (20mm) NPT, 125 psi (8.8 kg/cm ²)	1.3 (.6)
250-1IN-15	181920	Relief Valve 1 (25mm) NPT, 15 psi (1 kg/cm ²)	1.5 (.7)
250-1IN-30	181925	Relief Valve 1 (25mm) NPT, 30 psi (2.1 kg/cm ²)	1.5 (.7)
250-1IN-36	182025	Relief Valve 1 (25mm) NPT, 36 psi (2.5 kg/cm ²)	1.5 (.7)
250-1IN-40	182030	Relief Valve 1 (25mm) NPT, 40 psi (2.8 kg/cm ²)	1.5 (.7)
250-1IN-45	182125	Relief Valve 1 (25mm) NPT, 45 psi (3.2 kg/cm ²)	1.5 (.7)
250-1IN-50	182225	Relief Valve 1 (25mm) NPT, 50 psi (3.5 kg/cm ²)	1.5 (.7)
250-1IN-65	182235	Relief Valve 1 (25mm) NPT, 65 psi (4.6 kg/cm ²)	1.5 (.7)
250-1IN-75	182325	Relief Valve 1 (25mm) NPT, 75 psi (5.3 kg/cm ²)	1.5 (.7)
250-1IN-100	182425	Relief Valve 1 (25mm) NPT, 100 psi (7 kg/cm ²)	1.5 (.7)
250-1IN-125	182525	Relief Valve 1 (25mm) NPT, 125 psi (8.8 kg/cm ²)	1.5 (.7)
250-2IN-30	183025	Relief Valve 2 (50mm) NPT, 30 psi (2.1 kg/cm ²)	17.3 (7.8)
250-2IN-36	183125	Relief Valve 2 (50mm) NPT, 36 psi (2.5 kg/cm ²)	17.3 (7.8)
250-2IN-40	183175	Relief Valve 2 (50mm) NPT, 40 psi (2.8 kg/cm ²)	17.3 (7.8)
250-2IN-45	183225	Relief Valve 2 (50mm) NPT, 45 psi (3.2 kg/cm ²)	17.3 (7.8)
250-2IN-50	183325	Relief Valve 2 (50mm) NPT, 50 psi (3.5 kg/cm ²)	17.3 (7.8)

Valves (continued)

Series 260 Pressure Relief Valves

- For water tanks and hydronic heating systems
- Protects against over-pressure
- Minimizes hammering with flash steam
- Low differential pressure – 3 psi (.21 kg/cm²) between opening and closing
- Meets ASME Pressure Vessel and Boiler Code, Section IV
- Sealed spring chamber prevents scale or sediment build-up around seal
- 1½" (40mm) NPT Inlet and 2" (50mm) NPT Discharge
- Cast iron body, brass seat
- Maximum temperature 250°F (121°C)
- Maximum operating pressure range 30 - 50 psig (2.1 - 3.5 kg/cm²)



BOILER CONTROLS

Dimensions, in. (mm)

Size		A	B	C	D
NPT Inlet	NPT Outlet				
1½ (40)	2 (50)	6 (152)	2⅞ (73)	3¼ (83)	11 (279)

Performance

Model Number	Opening Pressure psig (kg/cm ²)	ASME Rating BTUH (K-Calories)
260-1 1/2IN-30	30 (2.1)	3,300,000 (13,095)
260-1 1/2IN-36	36 (2.5)	3,800,000 (15,079)
260-1 1/2IN-40	40 (2.8)	4,100,000 (16,270)
260-1 1/2IN-45	45 (3.2)	4,500,000 (17,857)
260-1 1/2IN-50	50 (3.5)	4,900,000 (19,444)

Ordering Information

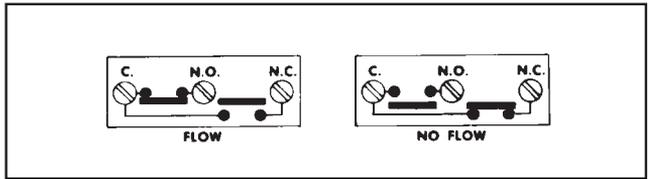
Model Number	Part Number	Description	Weight lbs. (kg)
260-1 1/2IN-30	182625	Relief Valve 1½ (40mm) NPT, 30 psi (2.1 kg/cm ²)	17.3 (7.8)
260-1 1/2IN-36	182725	Relief Valve 1½ (40mm) NPT, 36 psi (2.5 kg/cm ²)	17.3 (7.8)
260-1 1/2IN-40	182730	Relief Valve 1½ (40mm) NPT, 40 psi (2.8 kg/cm ²)	17.3 (7.8)
260-1 1/2IN-45	182825	Relief Valve 1½ (40mm) NPT, 45 psi (3.2 kg/cm ²)	17.3 (7.8)
260-1 1/2IN-50	182925	Relief Valve 1½ (40mm) NPT, 50 psi (3.5 kg/cm ²)	17.3 (7.8)

Liquid Flow Switches

The flow of liquids in pipelines plays an important role in industry and commerce. Under most circumstances it is essential to know whether or not there is a flow in a pipeline, and to act upon that knowledge. That is the reason for, and the function of, McDonnell & Miller Flow Switches.

A complete line of Liquid Flow Switches has been developed for a wide range of applications and literally hundreds of uses, including:

- Air Conditioning
- Hot Water Space Heating Systems
- Hot Water Supply Systems
- Pump Systems
- Water Cooled Equipment
- Blending or Additive Systems
- Liquid Transfer Systems
- Fire Sprinkler Systems
- Water Treatment Systems
- Swimming Pool Chlorination
- Industrial Laser Coolant System



In the tables of flow rates included in this catalog the word “Flow” means that switch will close one circuit and open the other, when flow rate is increased to the rate shown.

The words “No-Flow” mean the switch will reverse position—open first circuit and close the second—when flow rate is decreased to the rate shown.

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches	NEMA Enclosure
All Models	Type 1—General purpose indoor
FS1W, FS6W FS7-4W, FS8W	Type 4X—Watertight, Dust tight and Corrosion resistant
FS7-4E	Type 7—Hazardous Location (Class 1—Group C or D) Type 9—Hazardous Location (Class 2—Group E, F or G)

Models FS74E, FS74SE Flow Switches are Underwriters Laboratories Inc. Listed for use in these hazardous locations:

Class I, Division I, Group C – Atmospheres containing ethylether vapors, ethylene or cyclopropane.

Class I, Division I, Group D – Atmospheres containing gasoline, petroleum, naphtha, benzene, butane, propane, alcohols, acetone, benzol, lacquer solvent vapors or natural gas.

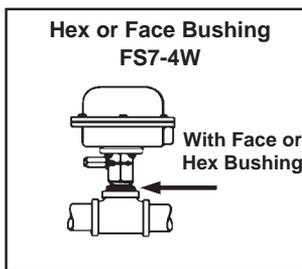
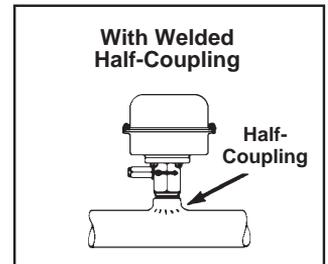
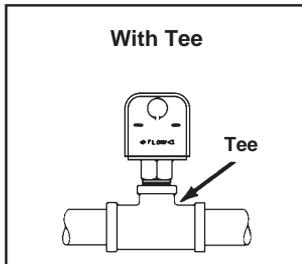
Class II, Division I, Group E – Atmospheres containing dust of aluminum, magnesium or their commercial alloys.

Class II, Division I, Group F – Atmospheres containing carbon black, coal or coke dust.

Class II, Division I, Group G – Atmospheres containing flour, starch or grain dusts.

Note: For other listings contact the factory.

Mounting Methods



How To Select Liquid Flow Switches

1. What function will the flow switch perform?

McDonnell & Miller Flow Switches are equipped with either one or two SPDT switches except for Model FS7-4A (Pneumatic). They can make or break an electrical circuit when flow starts or when flow stops, and can be used to:

- Actuate a signal when flow stops
- Start a motor with flow
- Shut off an alarm when flow is adequate
- Stop a motor with no flow

2. Size of pipe

McDonnell & Miller Flow Switches may be used on pipe sizes 1/2" - 36" (15 - 914mm) NPT.

3. How much flow is present?

The flow rate at which the flow switch is to respond should be determined next. McDonnell & Miller Flow Switches are actuated (make or break) with an increase in flow. The term "Flow" represents the actual movement (velocity) of liquid within a pipe sufficient to actuate the switch. The term "No-Flow" represents a decrease in velocity, or total flow stoppage, which will permit the switch to return to its original position.

IMPORTANT: In operation, the switch must be actuated by "Flow" before it can be reversed again by "No-Flow". All McDonnell & Miller Flow Switches can easily be adjusted in the field to require a higher actuating "Flow" or "No-Flow".

4. Maximum liquid pressure in pipe

The maximum pipeline pressure should be considered when selecting a particular model. Different flow switch models can accommodate a range of pipeline pressures up to 1000 psi (70kg/cm²).

5. Maximum temperature

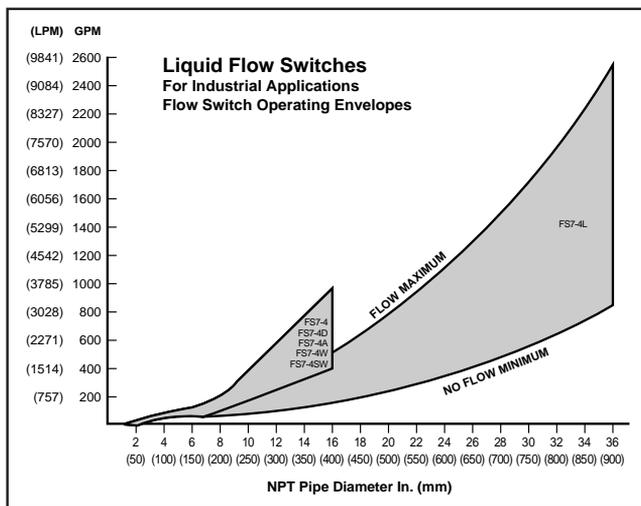
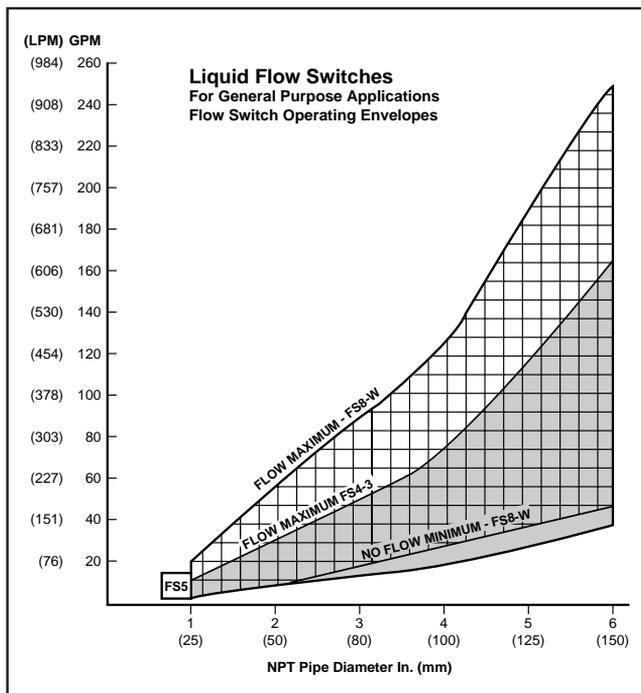
Determine the liquid and ambient atmospheric temperature when selecting the flow switch model. Various McDonnell & Miller Flow Switches can be used at ambient temperatures from 32°F (0°C) and liquid temperatures up to 300°F (149°C). If ambient temperatures are lower than 32°F (0°C) use the FS7-4W.

6. Type of liquid

McDonnell & Miller Flow Switch models have wetted parts of brass, monel or stainless steel. Depending on the particular model they may be used with water, certain light viscous fluids, some oils, various caustic solutions and other fluids.

7. Atmosphere surrounding flow switch

It should be determined if the location will be subject to high humidity, weather conditions or explosive atmospheres. Standard, water tight and hazardous duty flow switch models are available.



NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

FLOW SWITCHES

8. Incompressible fluids

Fluid flow within a pipe contains both laminar and turbulent flow. The desired placement of any flow switch is in the more predictable laminar flow regions. Turbulent flow is unpredictable, can cause false indications of flow speed and can cause damage to the flow sensing device. An obstruction of flow such as an elbow, fitting or inlet generates a turbulent wave or wake. For that reason placement is recommend at least 5 pipe diameters downstream for liquid flow switches.

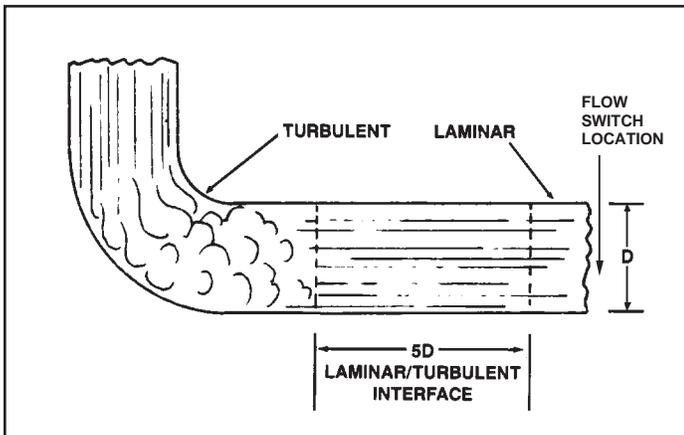
In any flow problem, the flow rate in either feet per second (fps) or gallons per minute (gpm) must be established. For your convenience, we have provided the formulas for determining flow in your application. Use the table (below right) to quickly determine the inside area of standard pipes. For nonstandard pipe schedules, determine the inside area by finding the inside diameter and applying the formula to the right.

Position of the Flow Switch

Installing the flow switch in a horizontal run of pipe is recommended. However because of space limitations, the only available installation may be in a vertical section of pipe. The Series FS4-3, FS8-W and FS5 may be used in this situation as they will generally operate satisfactorily when installed in a vertical pipe with either upward or downward flow (upward flow is preferable) **PROVIDED THERE IS NO UNUSUAL AMOUNT OF DIRT OR SEDIMENT IN THE WATER.**

Flow rates required to actuate the Series FS4-3, FS8W and FS5 are not available for vertical pipe installation. A "factory adjusted" flow switch normally does not require any field adjustment for upward or downward flow. But to make sure, it is advisable to hold flow switch in position to be installed and check for "no flow" switch operation by hand operation of the paddle.

The Series FS7-4, FS6, and FS1 **must** be mounted on upperside of horizontal pipe. These units will not operate properly on a vertical pipe.



Formulas

$$\text{Area} = D^2\pi/4$$

$$D = \text{Inside Diameter}$$

$$\pi = 3.14$$

Formula for large pipe, higher velocities

$$1. \text{ Velocity in ft. per sec. (FPS)} = \frac{\text{GPM} \times 0.321}{\text{Pipe Area in sq. in.}}$$

Example: With a flow of 1200 GPM through an 8" pipe, determine velocity.

$$\text{Velocity} = \frac{1200 \times 0.321}{50.0} \text{ or } 7.7 \text{ ft. per sec.}$$

$$2. \text{ GPM} = \frac{\text{Velocity in ft. per sec.} \times \text{Pipe Area sq. in.}}{0.321}$$

Example: With a flow of 6.5 ft. per sec. through a 10" pipe, determine GPM.

$$\text{GPM} = \frac{6.5 \times 78.9}{0.321} \text{ or } 1600 \text{ GPM}$$

3. LPM = Liters per Minute

$$\text{Velocity in meters per sec. (MPS)} = \frac{\text{LPM} \times .163}{\text{Pipe Area in cm}^2}$$

$$\text{LPM} = \frac{\text{Velocity in meters per sec.} \times \text{Pipe Area in cm}^2}{.163}$$

$$\text{GPM} = \text{LPM} \times .264 \quad \text{LPM} = \frac{\text{GPM}}{.264}$$

Nominal Standard Pipe Size in. (mm)	Pipe Schedule No.	Inside Area Sq. in. (cm ²) "A"
1/2 (15)	40S	.304 (1.96)
3/4 (20)	40S	.533 (3.44)
1 (25)	40S	.864 (5.57)
1 1/4 (32)	40S	1.496 (9.65)
1 1/2 (40)	40S	2.036 (13.14)
2 (50)	40S	3.36 (21.68)
2 1/2 (65)	40S	4.79 (30.90)
3 (80)	40S	7.39 (47.68)
3 1/2 (90)	40S	9.89 (63.81)
4 (100)	40S	12.73 (82.13)
5 (125)	40S	20.01 (129)
6 (150)	40S	28.89 (186)
8 (200)	40S	50.0 (322)
10 (250)	40S	78.9 (509)
12 (305)	30S	113.1 (730)
14 (356)	30S	137.9 (890)
16 (406)	30S	182.6 (1181)

Liquid Flow Switch Specification Chart

General Purpose Applications																
Model Number	Use on NPT Pipe Sizes		Connection		Wetted Parts					Maximum Pressure		Fluid Temperature °F (°C)		Minimum Ambient Temp. °F (°C)	Switch Enclosure	
	in.	mm	NPT	BSPT	Brass	Stainless Steel	Monel	Buna N	Viton	Solder	psi	kg/cm ²	Min.	Max.		
FS4-3	1-6	25-150	•		•		•			•	150	10.5	32 (0)	300 (149)	32 (0)	General Purpose
FS4-3D ¹	1-6	25-150	•		•		•			•	150	10.5	32 (0)	300 (149)	32 (0)	General Purpose
FS4-3J	1-6	25-150		•	•		•			•	150	10.5	32 (0)	300 (149)	32 (0)	General Purpose
FS4-3RP ²	1-6	25-150	•		•		•			•	150	10.5	32 (0)	300 (149)	32 (0)	General Purpose
FS4-3S	1-6	25-150	•			•	•			•	150	10.5	32 (0)	300 (149)	32 (0)	General Purpose
FS5-3/4	3/4	20	•		•			3			150	10.5	32 (0)	250 (121)	32 (0)	General Purpose
FS5-1	1	25	•		•			3			150	10.5	32 (0)	250 (121)	32 (0)	General Purpose
FS5-D-3/4 ¹	3/4	20	•		•			3			150	10.5	32 (0)	250 (121)	32 (0)	General Purpose
FS5-D-1 ¹	1	25	•		•			3			150	10.5	32 (0)	250 (121)	32 (0)	General Purpose
FS5-J-1	1	25		•	•			3			150	105	32 (0)	250 (121)	32 (0)	General Purpose
FS5-DJ-3/4 ¹	3/4	20		•	•			3			150	10.5	32 (0)	250 (121)	32 (0)	General Purpose
FS5-S-1	1	25	•			•		•			150	10.5	32 (0)	225 (107)	32 (0)	General Purpose
FS5-DS-1 ¹	1	25	•			•		•			150	10.5	32 (0)	225 (107)	32 (0)	General Purpose
FS8-W	1-6	25-150	•		•		•			•	150	10.5	32 (0)	225 (107)	32 (0)	NEMA 4-X
FS8-WJ	1-6	25-150		•	•		•			•	150	10.5	32 (0)	225 (107)	32 (0)	NEMA 4-X
High Sensitivity Applications																
FS6-3/4	3/4	20	•		•						100	7	32 (0)	225 (107)	32 (0)	General Purpose
FS6-1	1	25	•		•						100	7	32 (0)	225 (107)	32 (0)	General Purpose
FS6-J-3/4	3/4	20		•	•						100	7	32 (0)	225 (107)	32 (0)	General Purpose
FS6-J-1	1	25		•	•						100	7	32 (0)	225 (107)	32 (0)	General Purpose
FS6-W-3/4	3/4	20	•		•						100	7	32 (0)	225 (107)	32 (0)	NEMA 4-X
FS6-W-1	1	25	•		•						100	7	32 (0)	225 (107)	32 (0)	NEMA 4-X
FS6-WJ-3/4	3/4	20		•	•						100	7	32 (0)	225 (107)	32 (0)	NEMA 4-X
FS6-WJ-1	1	25		•	•						100	7	32 (0)	225 (107)	32 (0)	NEMA 4-X
FS1	1/2	15	•		•	•			•		100	7	32 (0)	225 (107)	32 (0)	General Purpose
FS1-J	1/2	15		•	•	•			•		100	7	32 (0)	225 (107)	32 (0)	General Purpose
FS1-W	1/2	15	•		•	•			•		100	7	32 (0)	225 (107)	32 (0)	NEMA 4-X

1 "D" Denotes 2 SPST Switches
 2 With reinforced Stainless Steel paddle
 3 Ethylene-Propylene Elastomer
 4 Brazed
 NEMA 4X flow switches are water tight, dust tight and corrosion resistant
 NEMA7, 9 flow switches are rated for hazardous duty

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

FLOW SWITCHES

Liquid Flow Switch Specification Chart (continued)

Industrial/Heavy Duty Applications															
Model Number	Use on NPT Pipe Sizes		Connection		Wetted Parts					Maximum Pressure		Fluid Temperature °F (°C)		Minimum Ambient	Switch Enclosure
	in.	mm	NPT	BSPT	Brass	Stainless Steel	Bronze	Teflon	Solder	psi	kg/cm ²	Min.	Max.	Temp. °F (°C)	
FS7-4	1 1/4 - 16	32-400	•		•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4A	1 1/4 - 16	32-400	•		•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4D ¹	1 1/4 - 16	32-400	•		•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4E	1 1/4 - 16	32-400	•		•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	NEMA 7, 9
FS7-4EJ	1 1/4 - 16	32-400		•	•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	NEMA 7, 9
FS7-4EL	8 - 32	200-800	•		•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	NEMA 7, 9
FS7-4ELJ	8 - 32	200-800		•	•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	NEMA 7, 9
FS7-4J	1 1/4 - 16	32-400		•	•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4DJ ¹	1 1/4 - 16	32-400		•	•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4L	8 - 32	200-800	•		•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4LJ	8 - 32	200-800		•	•	•	•	•	4	300	21	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4S	1 1/4 - 16	32-400	•			•		•	4	1000	70	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4DS ¹	1 1/4 - 16	32-400	•			•		•	4	1000	70	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4SE	1 1/4 - 16	32-400	•			•		•	4	1000	70	32 (0)	300 (149)	32 (0)	NEMA 7, 9
FS7-4SEJ	1 1/4 - 16	32-400		•		•		•	4	1000	70	32 (0)	300 (149)	32 (0)	NEMA 7, 9
FS7-4SJ	1 1/4 - 16	32-400		•		•		•	4	1000	70	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4SDJ ²	1 1/4 - 16	32-400		•		•		•	4	1000	70	32 (0)	300 (149)	32 (0)	General Purpose
FS7-4SW	1 1/4 - 16	32-400	•			•		•	4	1000	70	-65 (-54)	300 (149)	-65 (-54)	NEMA 4-X
FS7-4SWJ	1 1/4 - 16	32-400		•		•		•	4	1000	70	-65 (-54)	300 (149)	-65 (-54)	NEMA 4-X
FS7-4W	1 1/4 - 16	32-400	•		•	•	•	•	4	300	21	-65 (-54)	300 (149)	-65 (-54)	NEMA 4-X
FS7-4WJ	1 1/4 - 16	32-400		•	•	•	•	•	4	300	21	-65 (-54)	300 (149)	-65 (-54)	NEMA 4-X
FS7-4WL	8 - 32	200-800	•		•	•	•	•	4	300	21	-65 (-54)	300 (149)	-65 (-54)	NEMA 4-X
FS7-4WLJ	8 - 32	200 800		•	•	•	•	•	4	300	21	-65 (-54)	300 (149)	-65 (-54)	NEMA 4-X

1 "D" Denotes 2 SPST Switches
 2 With reinforced Stainless Steel paddle
 3 Ethylene-Propylene Elastomer
 4 Brazed
 NEMA 4X flow switches are water tight, dust tight and corrosion resistant
 NEMA 7, 9 flow switches are rated for hazardous duty

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Velocities

Gallons Per Minute (GPM)

Velocity FPS	Pipe Size											
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"
	GPM											
.2	.19	.33	.54	.94	1.27	2.1	3.0	4.8	6.2	7.9	12.5	18
.4	.38	.66	1.08	1.88	2.54	4.2	6.0	9.6	12.4	15.8	25.0	36
.6	.57	.99	1.62	2.92	3.81	6.2	8.9	13.4	18.6	23.7	37.5	54
.8	.76	1.32	2.16	3.76	5.08	8.3	11.9	19.2	24.8	31.6	50.0	72
1.0	.95	1.66	2.70	4.70	6.30	10.5	14.9	23.0	30.8	39.7	65.4	90
1.5	1.42	2.50	4.05	7.10	9.48	15.8	22.4	34.5	46.2	59.6	98.1	135
2.0	1.89	3.32	5.40	9.40	12.6	21.0	29.8	46.0	61.6	79.4	131	180
2.5	2.37	4.16	6.75	11.8	15.8	26.3	37.3	57.5	77.0	99.3	164	225
3.0	2.84	4.94	8.10	14.1	19.0	31.5	44.7	69.0	92.4	119	196	270
3.5	3.31	5.82	9.45	16.5	22.1	36.8	52.2	80.5	108	139	229	315
4.0	3.78	6.65	10.8	18.8	25.3	42.0	59.6	92.0	123	159	262	360
4.5	4.26	7.48	12.2	21.2	28.4	47.3	67.1	104	139	179	294	405
5.0	4.74	8.32	13.5	23.5	31.6	52.5	74.5	115	154	199	327	450
6.0	5.68	9.99	16.2	28.2	37.9	63.0	89.4	138	185	238	392	540
7.0	6.62	11.61	18.9	32.9	44.2	73.5	104	161	216	278	458	630
8.0	7.56	13.32	21.6	37.6	50.5	84.0	119	184	246	318	523	720
9.0	8.52	15.02	24.3	42.3	56.8	94.5	134	207	277	357	589	810
10.0	9.48	16.62	27.0	47.0	63.0	105	149	230	308	397	654	900

Liters Per Minute (LPM)

Velocity MPS	Pipe Size											
	15	20	25	32	40	50	65	80	90	100	125	150
	LPM											
.06	.72	1.25	2.04	3.56	4.81	7.95	11.4	18.2	23.5	29.9	47.3	68.1
.12	1.44	2.5	4.09	7.12	9.61	15.9	22.7	36.3	46.9	60	94.6	136.2
.18	2.16	3.75	6.13	11.1	14.4	23.5	33.7	50.7	70.4	89.7	141.6	204.4
.24	2.88	5	8.18	14.2	19.2	31.4	45	72	93.9	119.6	189.2	272.5
.30	3.6	6.3	10.2	17.8	23.9	39.7	56.4	87	116.6	150.3	247.5	340.7
.46	5.4	9.5	15.3	26.9	35.9	59.8	84.8	130.6	174.9	225.6	371.3	511
.61	7.2	12.6	20.5	35.4	47.6	79.5	112.8	174.1	233.2	300.5	495.8	681.3
.76	9	15.8	25.6	44.7	59.8	99.6	141.2	217.6	291.5	375.9	620.8	851.6
.91	10.8	18.7	30.7	53.4	71.9	119.2	169.2	261.2	349.7	450.4	741.9	1021.9
1.07	12.6	22	35.8	62.5	83.7	139.3	197.6	304.7	408.8	526.1	866.8	1192.3
1.22	14.3	25.2	40.9	71.2	95.8	159	225.6	348.2	465.6	601.8	991.7	1362.6
1.37	16.1	28.3	46.2	81.2	107.5	179	254	393.6	526.2	677.5	1112.8	1532.9
1.52	17.9	31.5	51.1	89	119.6	198.7	282	435.3	582.9	752.2	1237.7	1703.3
1.83	21.5	37.8	61.3	106.7	143.5	238.5	338.4	522.3	700.2	900.8	1483.7	2043.9
2.13	25.1	43.9	71.5	124.5	167.3	278.2	393.6	609.4	817.6	1052.2	1733.5	2384.6
2.44	28.6	50.4	81.8	144.3	191.1	317.9	450.4	696.4	931.1	1203.6	1979.6	2725.2
2.74	32.3	56.9	92	160.1	215	357.7	507.2	783.5	1048.5	1351.3	2229.4	3065.3
3.05	35.9	62.9	102.2	177.9	238.5	397.4	564	870.6	1165.8	1502.7	2475.4	3406.5

Pressure Drop

PSI

Pipe Size NPT (in.)	Series	Flow Rate (GPM)															
		.2	.5	1.0	2.0	4.0	8.0	10.0	15.0	20.0	25.0	30.0	50.0	75.0	100.0	150.0	200.0
1/2	FS1	.26	.32	.47	.72	2.74	9.74	14.4									
3/4 & 1	FS6	.01	.02	.03	.04	.36	1.44	2.16	4.86	7.94	12.3						
3/4	FS5 3/4"				1.75	2.25	2.80	3.10									
1	FS5 1"				1.75	2.25	2.80	3.10									
1	FS4-3					.15	.32	.54	1.26	2.20							
1	FS8-W				.01	.05	.20	.33	.74	1.30							
1 1/4	FS7-4					.03	.08	.17	.39	.72							
2	FS7-4						.02	.02	.04	.09	.13	.19	.51	.90			
3	FS4-3									.01	.01	.02	.05	.10	.18	.40	.79
3	FS8-W									.01	.01	.02	.06	.10	.13	.17	.19
4	FS7-4												.01	.02	.03	.05	.06
6	FS7-4													.01	.01	.02	.02

Kg/cm²

Pipe Size (mm)	Series	Flow Rate (LPM)															
		.76	1.89	3.79	7.57	15.1	30.3	37.9	56.8	75.7	94.6	113.6	189.3	283.9	378.5	567.8	757
15	FS1	.02	.02	.03	.05	.19	.68	1.01									
20 & 25	FS6	.001	.001	.002	.003	.025	.10	.15	.34	.56	.86						
20	FS5 3/4"				.12	.16	.20	.22									
25	FS5 1"				.12	.16	.20	.22									
25	FS4-3					.01	.02	.04	.09	.15							
25	FS8-W				.001	.004	.01	.02	.05	.09							
32	FS7-4					.002	.006	.01	.03	.05							
50	FS7-4						.08	.08	.15	.34	.49	.72	1.93	3.41			
80	FS4-3									.001	.001	.001	.004	.001	.001	.028	.055
80	FS8-W									.001	.001	.001	.004	.001	.009	.012	.013
100	FS7-4												.001	.001	.002	.004	.004
150	FS7-4													.001	.001	.001	.001

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

“K” Factors – adjusting paddle length

If the flow rate in the pipe exceeds the maximum adjustment on the Flow Switch a change can be made in the paddle length. Modifying the paddle length is a simple procedure that will adapt this equipment to a broader range of applications. Use the following formula as a guide when changing paddle lengths

$$\text{Paddle Length} = \frac{K}{\text{Flow Rate (GPM)}}$$

FS4-3 Example A

Calculate paddle length to provide switch action when flow in a 3 inch (76mm) pipe increases to 100 GPM (366 LPM)

Use Maximum Adjustment Flow

$$L = \frac{162.5}{100} = 1.625 \text{ in. (41.27mm)}$$

FS7-4 Example B

Calculate paddle length to provide switch action when flow in a 3 inch (76mm) pipe increases to 100 GPM (366 LPM)

Use Maximum Adjustment Flow

$$L = \frac{92.94}{100} = .93 \text{ in. (23.62mm)}$$

FS7-4 Example C

Calculate paddle length to provide switch action when flow in a 12 inch (305mm) pipe decreases to 1200 GPM (4392 LPM)

Use Maximum Adjustment No-Flow

$$L = \frac{2439.8}{1200} = 2.033 \text{ in. (51.63mm)}$$

FS8W Example D

Calculate paddle length to provide switch action when flow in a 4 inch (102mm) pipe increases to 200 GPM (732 LPM)

Use Maximum Adjustment Flow

$$L = \frac{442}{200} = 2.21 \text{ in. (56.13mm)}$$

FS4-3 “K” Factor

Pipe Size NPT in. (mm)	Flow Maximum Adjustment	No-Flow Maximum Adjustment
2 (50)	69.2	50.3
3 (80)	162.5	143.5
4 (100)	276.0	241.0
5 (125)	550.0	440.0
6 (150)	977.0	728.0

FS7-4 “K” Factor

Pipe Size NPT in. (mm)	Flow Maximum Adjustment	No-Flow Maximum Adjustment
2 (50)	34.63	30.43
2½ (65)	54.00	47.46
3 (80)	92.94	81.69
3½ (90)	133.67	117.49
4 (100)	183.35	161.15
5 (125)	322.61	283.55
6 (150)	510.70	448.87
7 (180)	705.05	619.67
8 (200)	1014.47	891.62
9 (230)	1302.47	1144.79
10 (250)	1791.70	1574.74
12 (300)	2776.04	2439.88
14 (350)	3729.02	3255.02
16 (400)	4869.81	4250.81
18 (450)	6164.08	5380.57
20 (500)	7661.11	6687.31
30 (750)	18202.0	15888.0

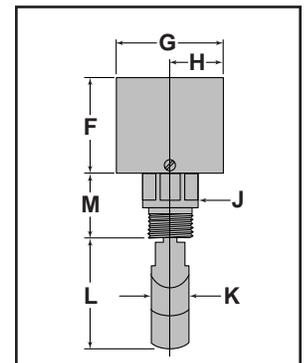
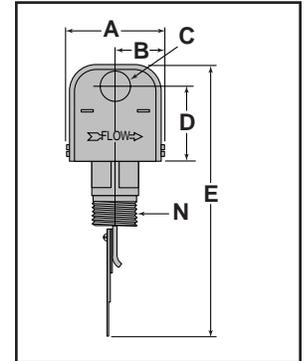
FS8-W “K” Factor

Pipe Size NPT in. (mm)	Flow Maximum Adjustment	No-Flow Maximum Adjustment
2 (50)	118.5	99.5
3 (80)	278.0	227.0
4 (100)	442.0	391.0
5 (125)	847.0	762.0
6 (150)	1440.0	1325.0

Flow Switches – Liquid

Series FS4-3 General Purpose Liquid Flow Switches

- Universal design serves the widest variety of applications
- For starting or stopping electrically operated equipment such as signal lights, alarms, motors, automatic burners, metering devices and others
- Replacement for Johnson Controls flow switch Model F61KB-11
- 1" (25mm) NPT
- Two electrical knock-outs allows connection from either end
- Sensitivity adjusting screw makes flow adjustment easy
- Single pole, double throw snap switch
- Hardened stainless steel bearings minimize friction
- Sealed Monel bellows
- Four Monel paddles included-1", 2", 3" & 6" (25, 50, 80, & 150mm) NPT
- Optional features
 - Time delay (5 or 20 seconds)
 - Two SPDT switches to make or break two separate circuits
 - Reinforced paddles
 - Materials of construction suitable for corrosive liquids
 - Sprinkler service (UL & ULC listed)-Model FS4-3F
 - BSPT threads
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 300°F (149°C)
- Maximum pressure 150 psi (10.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E	F	G
3 (76)	1½ (38)	7⁄8 (22)	27⁄32 (56)	87⁄16 (211)	215⁄16 (75)	33⁄8 (86)
H	J	K	L	M	N NPT	
111⁄16 (43)	17⁄16 (37)	11⁄8 (29)	37⁄16 (87)	21⁄16 (52)	1 (25)	

Flow Switches – Liquid (continued)

Series FS4-3 (continued) General Purpose Liquid Flow Switches

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	No Flow gpm (lpm)	
1 (25)	Factory or Minimum	6 (22.7)	3.6 (13.6)	27
	Maximum	10.2 (38.6)	9.2 (34.8)	
1¼ (32)	Factory or Minimum	9.8 (37.1)	5.6 (21.2)	47
	Maximum	16.8 (63.6)	15 (56.8)	
1½ (40)	Factory or Minimum	12.7 (48.1)	7 (26.5)	63
	Maximum	23 (87.1)	19.5 (73.8)	
2 (50)	Factory or Minimum	18.8 (71.2)	9.4 (35.6)	105
	Maximum	32.8 (124.1)	24 (90.8)	
2½ (65)	Factory or Minimum	24.3 (92)	11.6 (43.9)	149
	Maximum	42.4 (160.5)	37.5 (141.9)	
3 (80)	Factory or Minimum	30 (113.6)	12 (45.4)	230
	Maximum	52.1 (197.2)	46.1 (174.5)	
4 (100)	Factory or Minimum	39.7 (150.3)	19.8 (74.9)	397
	Maximum	73.5 (278.2)	64.2 (242)	
5 (125)	Factory or Minimum	58.7 (222.2)	29.3 (110.9)	654
	Maximum	115 (435.3)	92 (348.2)	
6 (150)	Factory or Minimum	79.2 (300)	39.6 (150)	900
	Maximum	166 (628.3)	123 (465.6)	

Values are ± 10%

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS4-3	114400	Liquid flow switch	2.3 (1.0)
FS4-3D	114550	FS4-3 w/2 SPDT switches	3.3 (1.5)
FS4-3F	114625	FS4-3 for sprinkler service	2.3 (1.0)
FS4-3J	114610	FS4-3 w/BSPT threads	2.0 (0.9)
FS4-3S	114641	FS4-3 w/SS/monel construction	2.3 (1.0)
FS4-3DS	114642	FS4-3 w/SS/monel & w SPDT switches	3.3 (1.5)
FS4-3RP	114650	FS4-3 w/reinforced paddle	2.3 (1.0)
FS4-3-5R	114405	FS4-3 w/5 second delay on break	2.3 (1.5)
FS4-3-20	114425	FS4-3 w/20 second delay on make	2.3 (1.5)

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

For Model FS4-3F & FS4-3DF

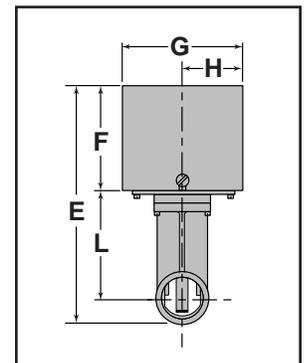
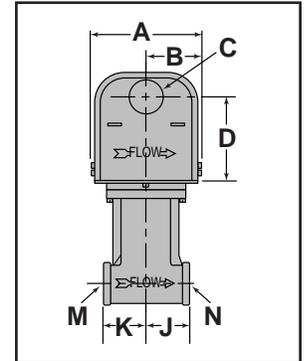
NPT Pipe Size In. (mm)	Paddle to use Length	TEE Size
1" (25)	1 ¹¹ / ₃₂ " as furnished	1" x 1" x 1" NPT Tee
1¼" (32)	Trim 1½" pipe size paddle with template furnished	1¼" x 1¼" x 1" NPT Tee (Paddle must be bowed for insertion into 1¼" tee)
1½" (40)	2 1/16" as furnished	1½" x 1½" x 1" NPT Tee (Paddle must be bowed for insertion into 1½" tee)

NOTE: ONLY LISTED PIPE SIZES MEET UL REQUIREMENTS FOR FIRE SPRINKLER SYSTEMS.

Flow Switches – Liquid

Series FS4-3T General Purpose Liquid Flow Switches

- For starting or stopping electrically operated equipment such as signal lights, alarms, motors, automatic burners, metering devices and others
- In-line configuration eliminates need for a pipe tee
- Sizes available
 - 3/4" (20mm) NPT
 - 1" (25mm) NPT
- Paddles available for low, medium or high flow
- Two electrical knock-outs allows connection from either end
- Sensitivity adjusting screw makes flow adjustment easy
- Single pole, double throw snap switch
- Hardened stainless steel bearings minimize friction
- Sealed Monel bellows
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 300°F (149°C)
- Maximum pressure 150 psi (10.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E	F	G
3 (76)	1 1/2 (38)	7/8 (22)	2 7/32 (56)	6 7/8 (175)	2 15/16 (75)	3 3/8 (86)

H	J	K	L	M NPT	N NPT
1 11/16 (43)	1 5/16 (33)	1 1/8 (29)	3 1/16 (78)	3/4 or 1 (20 or 25)	3/4 or 1 (20 or 25)

Flow Switches – Liquid (continued)

Series FS4-3T (continued) General Purpose Liquid Flow Switches

Flow Rates

Pipe Model Number	Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
			Flow gpm (lpm)	No Flow gpm (lpm)	
FS4-3T1-3/4	3/4 (20)	Factory or Minimum	4.4 (16.7)	2.6 (9.8)	16.62
		Maximum	10.5 (39.7)	9.8 (37.1)	
FS4-3T2-3/4	3/4 (20)	Factory or Minimum	3.7 (14)	2.2 (8.3)	
		Maximum	8.9 (33.7)	8.3 (31.4)	
FS4-3T3-3/4	3/4 (20)	Factory or Minimum	2 (7.6)	1.2 (4.5)	
		Maximum	4.5 (17)	4.1 (15.5)	
FS4-3T1-1	1 (25)	Factory or Minimum	5 (18.9)	3.2 (12.1)	27
		Maximum	11.5 (43.5)	11 (41.6)	
FS4-3T2-1	1 (25)	Factory or Minimum	4.8 (18.1)	2.9 (11)	
		Maximum	10.1 (38.2)	9.4 (35.6)	
FS4-3T3-1	1 (25)	Factory or Minimum	2 (7.6)	1.2 (4.5)	
		Maximum	4.5 (17)	4.1 (15.5)	

Values are ± 10%

Ordering Information

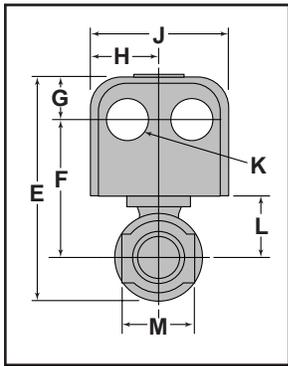
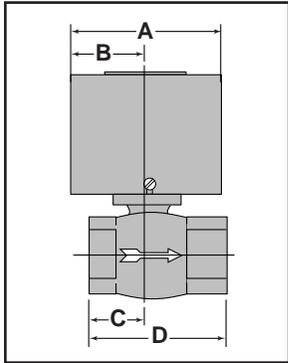
Model Number	Part Number	Description	Weight lbs. (kg)
FS4-3T1-3/4	114800	FS4-3 high flow w/3/4" (20mm) NPT pipe tee	3 (1.4)
FS4-3T1-1	115100	FS4-3 high flow w/1" (25mm) NPT pipe tee	3 (1.4)
FS4-3T2-3/4	114900	FS4-3 med. flow w/3/4" (20mm) NPT pipe tee	3 (1.4)
FS4-3T2-1	115200	FS4-3 med. flow w/1" (25mm) NPT pipe tee	3 (1.4)
FS4-3T3-3/4	115000	FS4-3 low flow w/3/4" (20mm) NPT pipe tee	3 (1.4)
FS4-3T3-1	115300	FS4-3 low flow w/1" (25mm) NPT pipe tee	3 (1.4)

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid

Series FS5 General Purpose Liquid Flow Switches

- For general purpose applications requiring low flow rate sensitivity
- In-line configuration eliminates need for a pipe tee
- Sizes available
 - 3/4" (20mm) NPT
 - 1" (25mm) NPT
- Materials of construction
 - Brass, carbon & EPDM elastomer (for water); Models FS5 & FS5-D
 - Stainless steel, carbon & Buna N (for water or water and petroleum base compounds) Models FS5-S & FS5-DS
- Single pole, double throw snap switch
- Sensitivity adjusting screw makes flow adjustment easy
- Optional feature
 - BSPT threads
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature
 - 225°F (107°C) – Stainless Steel models
 - 250°F (121°C) – Brass
- Maximum operating pressure 150 psi (10.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D
3 ⁷ / ₁₆ (87)	1 ⁹ / ₁₆ (40)	1 ⁵ / ₁₆ (33)	3 ³ / ₁₆ (56)
E	F	G	H
5 ¹ / ₁₆ (129)	3 ¹ / ₄ (83)	7 ⁷ / ₈ (22)	1 ¹⁹ / ₃₂ (40.5)
J	K	L	M
3 ³ / ₁₆ (81)	7 ⁷ / ₈ (22)	1 ³ / ₈ (35)	1 ¹¹ / ₁₆ (43)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS5-3/4	114760	Flow switch w/3/4" (20mm) NPT	2.5 (1.1)
FS5-1	114780	Flow switch w/1" (25mm) NPT	2.5 (1.1)
FS5-D-3/4	114763	FS5-3/4 w/2 SPDT switches	2.5 (1.1)
FS5-D-1	114783	FS5-1 w/2 SPDT switches	2.5 (1.1)
FS5-DS-1	114793	FS5-D-1 w/stainless steel	2.5 (1.1)
FS5-S-1	114795	FS5-1 w/stainless steel	2.3 (1.0)
FS5-J-3/4	114765	FS5-3/4 w/BSPT threads	2.5 (1.1)
FS5-J-1	114785	FS5-1 w/BSPT threads	2.5 (1.1)

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	No Flow gpm (lpm)	
3/4 (20) or 1 (25)	Factory or Minimum	1.5 (5.7)	1.1 (4.2)	16.62
	Maximum	15 (56.8)	10 (37.9)	27

Values are ± 10%

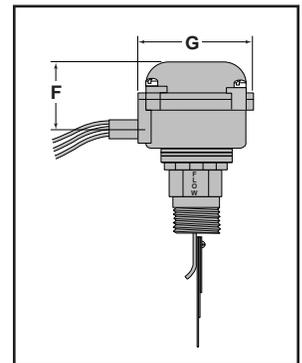
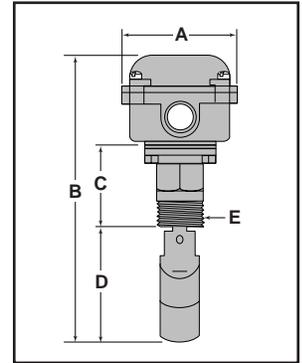
NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid (continued)

Series FS8-W

General Purpose Liquid Flow Switches

- For general purpose applications with environmental exposure, or those requiring a water-tight, dust tight, or a NEMA 4X rated flow switch
- 1" (25mm) NPT
- Sealed Monel bellows
- Single pole, double throw snap switch
- Four Monel paddles included. Fits 1", 2", 3", 6" (25, 50, 80, 150mm) NPT, or the extended paddle can be trimmed to fit other pipe sizes
- Sensitivity adjusting screw makes flow adjustment easy
- Optional features
 - BSPT threads
 - Gold plated contacts
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 225°F (107°C)
- Maximum operating pressure 150 psi (10.5 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E NPT	F	G
3 ¹ / ₄ (83)	8 ³ / ₈ (213)	2 ⁵ / ₁₆ (59)	3 ⁷ / ₁₆ (87)	1 (25)	1 ³ / ₄ (45)	3 ¹ / ₄ (83)

FLOW SWITCHES

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation				Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	Velocity fps (mps)	No Flow gpm (lpm)	Velocity fps (mps)	
1 (25)	Factory or Minimum	4.9 (18.5)	1.82 (.55)	3.4 (12.9)	1.25 (.38)	27
	Maximum	17.6 (66.6)	6.53 (2.60)	15 (56.8)	5.56 (1.69)	
1¼ (32)	Factory or Minimum	7.5 (28.4)	1.60 (.49)	5.3 (20.1)	1.14 (.35)	47
	Maximum	29 (110)	6.23 (1.9)	24.6 (93.1)	5.28 (1.61)	
1½ (40)	Factory or Minimum	9.4 (35.6)	1.48 (.45)	6.7 (25.4)	1.05 (.32)	63
	Maximum	37.8 (143)	5.95 (1.81)	32.2 (122)	5.07 (1.54)	
2 (50)	Factory or Minimum	13.7 (51.8)	1.31 (.4)	9.4 (35.6)	.9 (.27)	105
	Maximum	56.4 (214)	5.39 (1.64)	47.4 (179)	4.53 (1.38)	
2½ (65)	Factory or Minimum	17.9 (67.8)	1.20 (.36)	12.1 (45.8)	.81 (.25)	149
	Maximum	71.3 (270)	4.78 (1.46)	59.2 (224)	3.97 (1.21)	
3 (80)	Factory or Minimum	24.2 (91.6)	1.05 (.32)	16.4 (62.1)	.71 (.22)	230
	Maximum	89 (337)	3.87 (1.18)	72.5 (274)	3.15 (.96)	
4 (100)	Factory or Minimum	35.3 (134)	.89 (.27)	27 (102)	.68 (.21)	397
	Maximum	118 (446)	2.89 (.91)	105 (397)	2.64 (.8)	
5 (125)	Factory or Minimum	48.6 (184)	.78 (.24)	37.4 (142)	.6 (.18)	654
	Maximum	178 (674)	2.86 (.87)	160 (606)	2.57 (.78)	
6 (150)	Factory or Minimum	60.3 (228)	.67 (.20)	46.8 (177)	.52 (.16)	900
	Maximum	245 (927)	2.72 (.83)	225 (852)	2.5 (.76)	

Values are ± 10%

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS8-W	120601	Flow switch NEMA 4X rated	1.7 (.77)
FS8-WG	120603	FS8 w/gold plated contacts	2.0 (.9)
FS8-WG-SL	120604	FS8-WG w/gold plated contacts & sealed leads	2.0 (.9)
FS8-WJ	120602	FS8 w/BSPT threads	2.0 (.9)
FS8-WJA	120751	FS8-WJ w/adjusting indicator	2.0 (.9)

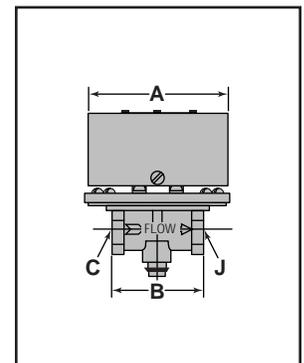
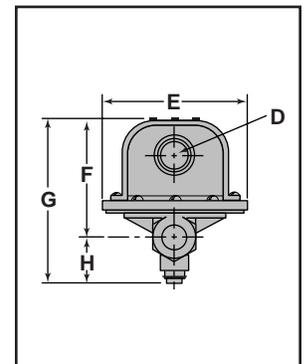
NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid (continued)

Series FS1

High Sensitivity Liquid Flow Switches

- For general purpose applications where high sensitivity is required and moderate or low flow rates are encountered such as air conditioning, heating and hydronic systems, water, fuel oil, some viscous liquids and oils in process work
- In-line configuration eliminates need for a pipe tee
- High flow capacity
- 1/2" (15mm) NPT
- Single pole, double throw snap switch
- Switch compartment is completely sealed to protect it from the liquid
- Sensitivity adjusting screw makes flow adjustment easy
- Optional features
 - BSPT threads
 - Gold plated contacts
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 225°F (107°C)
- Maximum operating pressure 100 psi (7 kg/cm²)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

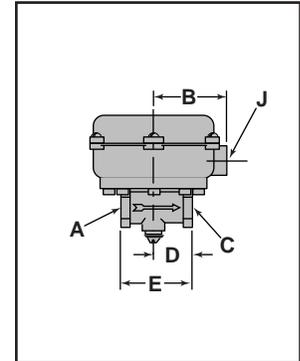
Dimensions, in. (mm)

A	B	C NPT	D	E	F	G	H	J NPT
3 ³ / ₄ (95)	2 ⁵ / ₈ (67)	1/2 (15)	7/8 (22)	3 ¹³ / ₁₆ (97)	3 ³ / ₁₆ (81)	4 ⁷ / ₁₆ (113)	1 ¹ / ₄ (32)	1/2 (15)

Flow Switches – Liquid

Model FS1-W High Sensitivity Liquid Flow Switches

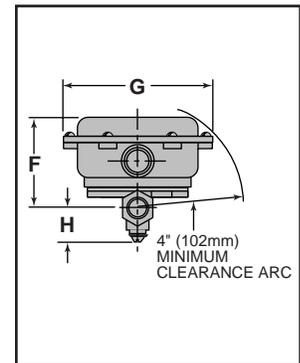
- For applications requiring a water-tight, dust-tight, or a NEMA 4X rated flow switch



Dimensions, in. (mm)

A NPT	B	C NPT	D	E
1/2 (15)	2 5/8 (67)	1/2 (15)	1 3/8 (35)	2 5/8 (67)

F	G	H	J NPT
3 7/16 (87)	5 1/2 (140)	1 1/4 (32)	1/2 (15)



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS1	113200	High sensitivity flow switch	1.7 (.77)
FS1-G	113250	FS1 w/gold plated contacts	3.0 (1.4)
FS1-J	113550	FS1 w/BSPT threads	3.0 (1.4)
FS1-W	113601	FS1 NEMA 4X rated	3.3 (1.5)

Flow Rates

Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
	Flow gpm (lpm)	No Flow gpm (lpm)	
Factory or Minimum	0.41 (1.55)	0.24 (.91)	9.48
Maximum	1.81 (6.85)	1.28 (4.84)	

Values are ± 10%

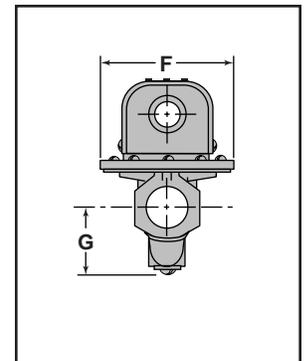
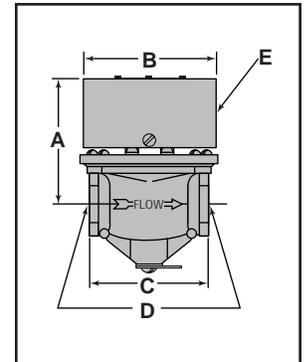
NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid (continued)

Series FS6

High Sensitivity Liquid Flow Switches

- For heavy duty applications where high sensitivity is required, such as water treatment systems, cooling systems for electronic circuits, compressors, booster pumps, and bearings, and other applications that need instant switching
- In-line configuration eliminates need for a pipe tee
- Very high flow capacity
- Actuates at extremely low flow rate
- Sizes available
 - 3/4" (20mm) NPT
 - 1" (25mm) NPT
- Single pole, double throw snap switch
- Switch compartment is completely sealed to protect it from the liquid
- Sensitivity adjusting screw makes flow adjustment easy
- Optional feature
 - BSPT threads
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 225°F (107°C)
- Maximum operating pressure 100 psi (7 kg/cm²)



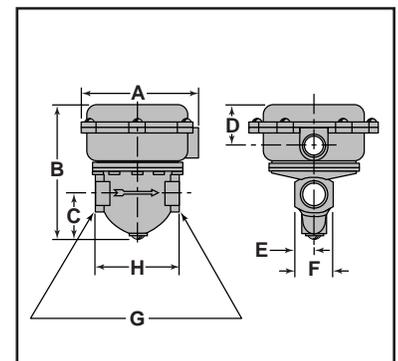
Dimensions, in. (mm)

A	B	C	D NPT	E	F	G
3 1/2 (89)	3 23/32 (94.4)	3 3/8 (86)	3/4 or 1 (20 or 25)	7/8 (22)	3 3/4 (95)	2 (51)

Model FS6-W

High Sensitivity Liquid Flow Switches

- For applications requiring a water-tight, dust-tight, or a NEMA 4X rated flow switch



Dimensions, in. (mm)

A	B	C	D	E	F	G NPT	H
5 (127)	5 3/4 (146)	2 (51)	1 5/8 (41)	2 9/32 (23)	1 13/16 (46)	3/4 or 1 (20 or 25)	3 3/8 (86)

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	No Flow gpm (lpm)	
3/4 (20) or 1 (25)	Factory or			
	Minimum	.12 (.45)	.06 (.23)	16.62
	Maximum	2.5 (9.46)	1.5 (5.68)	27

Values are ± 10%

Ordering Information

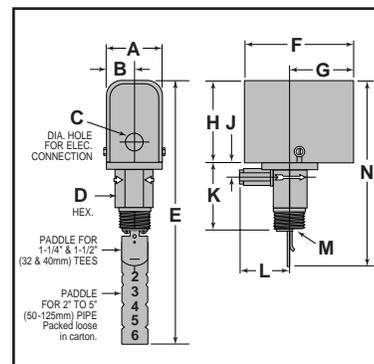
Model Number	Part Number	Description	Weight lbs. (kg)
FS6-3/4	115400	Very high sensitivity flow switch w/3/4" (20mm) NPT	4.5 (2)
FS6-1	115600	Very high sensitivity flow switch w/1" (25mm) NPT	4.5 (2)
FS6-J-3/4	115550	FS6-3/4 w/BSPT threads	4.5 (2)
FS6-J-1	115650	FS6-1 w/BSPT threads	4.5 (2)
FS6-W-3/4	115651	FS6-3/4 NEMA 4X rated	4.5 (2)
FS6-W-1	115652	FS6-1 NEMA 4X rated	4.5 (2)
FS6-WJ-3/4	115653	FS6-W-3/4 w/BSPT threads	4.5 (2)
FS6-WJ-1	115654	FS6-W-1 w/BSPT threads	4.5 (2)

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid (continued)

Series FS7-4 Industrial Liquid Flow Switches

- Universal design serves the widest variety of large pipe applications, including heating and hydronic systems, air conditioning, refrigeration and process work
- 1 1/4" (32mm) NPT
- Brass with sealed tube construction
- Single pole, double throw snap switch
- Magnetic switching mechanism eliminates need for bellows
- Sensitivity adjusting screw makes flow adjustment easy
- Paddles can be trimmed to suit application needs
- Optional features
 - Extended paddle arm
 - Two SPDT switches to make or break two separate circuits
 - Stainless steel
 - BSPT threads
 - Sprinkler service (UL & ULC listed)-Model FS7-4F
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 300°F (149°C)
- Maximum operating pressure
 - 300 psi (21 kg/cm²)
 - 1000 psi (70 kg/cm²) – Stainless Steel models



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E	F	G
2 7/8 (73)	1 7/16 (37)	7/8 (22)	1 3/4 (45)	13 9/16 (345)	5 13/16 (148)	3 3/8 (86)
H	J	K	L	M	N	
4 1/8 (105)	1 5/16 (24)	3 7/16 (87)	2 5/8 (67)	1 1/4 (32) NPT	9 1/2 (241)	

FLOW SWITCHES

Flow Rates

Model	Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
			Flow gpm (lpm)	No Flow gpm (lpm)	
FS7-4	1 1/4 (32)	Factory or Minimum	4.8 (18.2)	3 (11.4)	47
		Maximum	7.7 (29.1)	5.9 (22.3)	
	1 1/2 (40)	Factory or Minimum	6.3 (23.8)	3.6 (13.6)	63
		Maximum	10 (37.9)	7 (26.5)	
	2 (50)	Factory or Minimum	9.9 (37.5)	5.9 (22.3)	105
		Maximum	15.8 (59.8)	11 (41.6)	
	2 1/2 (60)	Factory or Minimum	15.3 (57.9)	9.5 (36)	149
		Maximum	23.7 (89.7)	17 (64.3)	
	3 (80)	Factory or Minimum	24.4 (92.4)	15.4 (58.3)	230
		Maximum	35.5(134.4)	29.2(110.5)	
	4 (100)	Factory or Minimum	33.3 (126)	21.1 (79.9)	397
		Maximum	61.4(232.4)	37.7(142.7)	
	5 (125)	Factory or Minimum	44.4(168.1)	31 (117.3)	654
		Maximum	84 (317.9)	51 (193)	
	6 (150)	Factory or Minimum	56.3(213.1)	48.7(184.3)	900
		Maximum	114.8(434.5)	71 (270.6)	
	8 (200)*	Factory or Minimum	104(393.6)	89 (336.9)	1,500
		Maximum	210(794.9)	131(495.8)	
10 (250)*	Factory or Minimum	184(696.4)	157(594.2)	2,500	
	Maximum	369 (1397)	231(874.3)		
12 (300)*	Factory or Minimum	289 (1094)	247(934.9)	3,500	
	Maximum	582 (2203)	363 (1374)		
14 (355)*	Factory or Minimum	387 (1465)	323 (1223)	4,000	
	Maximum	753 (2850)	495 (1874)		
16 (405)*	Factory or Minimum	513 (1942)	428 (1620)	5,000	
	Maximum	998 (3777)	656 (2483)		
FS7-4L	20 (500)*	Factory or Minimum	520 (1968)	260 (984)	8,000
		Maximum	780 (2952)	693 (2623)	
	24 (600)*	Factory or Minimum	752 (2846)	376 (1423)	12,000
		Maximum	1128(4269)	1002(3793)	
	30 (760)*	Factory or Minimum	1177(4455)	589 (2229)	20,200
		Maximum	1766(6684)	1570(59842)	
	36 (910)*	Factory or Minimum	1723(6522)	861 (3259)	28,270
		Maximum	2584(9870)	2297(8694)	

Values are ± 10%
* Equipped with a 6" (152mm) paddle

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS7-4	119700	Industrial flow switch	5.5 (2.5)
FS7-4D	119750	FS7-4 w/2 SPDT switches	5.7 (2.6)
FS7-4DF	119825	FS7-4D for sprinkler service (UL listed)	5.7 (2.6)
FS7-4DS	119760	FS7-4D w/Stainless steel	5.7 (2.6)
FS7-4F	119800	FS7-4 for sprinkler service (UL listed)	5.5 (2.5)
FS7-4F CAN	119801	FS7-4F ULC listed	5.5 (2.5)
FS7-4J	120060	FS7-4 w/ BSPT threads	5.5 (2.5)
FS7-4L	119900	FS7-4 w/extended paddle arm	5.5 (2.5)
FS7-4LJ	119980	FS7-4L w/BSPT threads	5.5 (2.5)
FS7-4S	120160	FS7-4 w/Stainless steel	5.0 (2.3)
FS7-4SJ	120171	FS7-4S w/BSPT threads	5.0 (2.3)
FS7-DSJ	120174	FS7-4S w/2 SPDT switches & BSPT threads	5.0 (2.3)

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

For Model FS7-4F Only

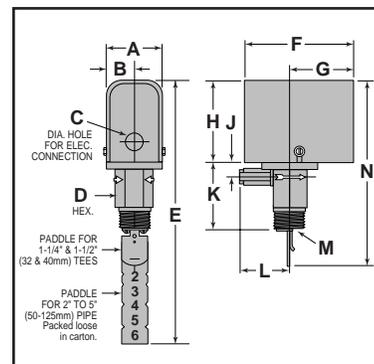
NPT Pipe Size In (mm)	Paddle to use Length	TEE Size NPT
1 1/4 (32)	1 13/16" as furnished	1 1/4" x 1 1/4" x 1 1/4" Tee
1 1/2 (40)	Trim 2" pipe size paddle with template furnished	1 1/2" x 1 1/2" x 1" NPT Tee
2 (50)	2 9/16" as furnished	2" x 2" x 1 1/4" Tee
2 1/2 (60)	3" as furnished	2 1/2" x 2 1/2" x 1 1/4" Tee (Paddle must be bowed to insert into 1 1/4" NPT opening)

NOTE: ONLY LISTED PIPE SIZES MEET UL REQUIREMENTS FOR FIRE SPRINKLER SYSTEMS.

Flow Switches – Liquid (continued)

Series FS7-4A Industrial Liquid Flow Switches

- For pneumatic control applications
- 1/4" (32mm) NPT
- 1/8" (4mm) NPT air line tapping
- Brass with sealed tube construction
- Air valve
- Sensitivity adjusting screw makes flow adjustment easy
- Paddles can be trimmed to suit application needs
- Minimum temperature (fluid or ambient) -32°F (0°C)
- Maximum temperature 300°F (149°C)
- Maximum air valve pressure 50 psi (3.5 kg/cm²)
- Maximum operating pressure 300 psi (7 kg/cm²)



Dimensions, in. (mm)

A	B	C	D	E	F	G
2 7/8 (73)	1 7/16 (37)	7/8 (22)	1 3/4 (45)	13 9/16 (349)	5 13/16 (148)	3 3/8 (86)
H	J	K	L	M	N	
4 1/8 (105)	1 5/16 (24)	3 7/16 (87)	2 5/8 (67)	1 1/4 (32) NPT	9 1/2 (241)	

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	No Flow gpm (lpm)	
1¼ (32)	Factory or Minimum	4.8 (18.2)	3 (11.4)	47
	Maximum	7.7 (29.1)	5.9 (22.3)	
1½ (40)	Factory or Minimum	6.3 (23.8)	3.6 (13.6)	63
	Maximum	10 (37.9)	7 (26.5)	
2 (50)	Factory or Minimum	9.9 (37.5)	5.9 (22.3)	105
	Maximum	15.8 (59.8)	11 (41.6)	
2½ (65)	Factory or Minimum	15.3 (57.9)	9.5 (36)	149
	Maximum	23.7 (89.7)	17 (64.3)	
3 (80)	Factory or Minimum	24.4 (92.4)	15.4 (58.3)	230
	Maximum	35.5 (134.4)	29.2 (110.5)	
4 (100)	Factory or Minimum	33.3 (126)	21.1 (79.9)	397
	Maximum	61.4 (232.4)	37.7 (142.7)	
5 (125)	Factory or Minimum	44.4 (168.1)	31 (117.3)	654
	Maximum	84 (317.9)	51 (193)	
6 (150)	Factory or Minimum	56.3 (213.1)	48.7 (184.3)	900
	Maximum	114.8 (434.5)	71 (270.6)	
8 (200)*	Factory or Minimum	104 (393.6)	89 (336.9)	1,500
	Maximum	210 (794.9)	131 (495.8)	
10 (250)*	Factory or Minimum	184 (696.4)	157 (594.2)	2,500
	Maximum	369 (1397)	231 (874.3)	
12 (300)*	Factory or Minimum	289 (1094)	247 (934.9)	3,500
	Maximum	582 (2203)	363 (1374)	
14 (355)*	Factory or Minimum	387 (1465)	323 (1223)	4,000
	Maximum	753 (2850)	495 (1874)	
16 (405)*	Factory or Minimum	513 (1942)	428 (1620)	5,000
	Maximum	998 (3777)	656 (2483)	

Values are ± 10%

* Equipped with a 6" (152mm) paddle

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS7-4A	119710	Industrial flow switch w/air valve	5.5 (2.5)

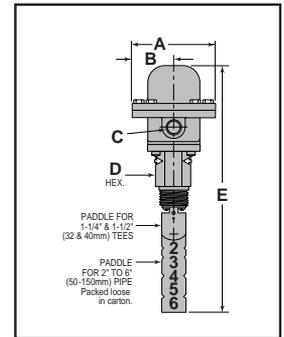
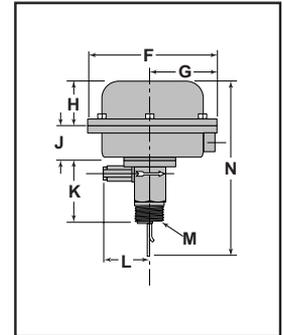
NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid (continued)

Series FS7-4E

Industrial Liquid Flow Switches

- For hazardous environment applications requiring a **NEMA 7 (Class I, Group C or D) or NEMA 9 Class II, Group E, F, or G** rated flow switch
- 1¼" (32mm) NPT
- Brass with sealed tube construction
- Single pole, double throw snap switch
- Magnetic switching mechanism
- Sensitivity adjusting screw makes flow adjustment easy
- Paddles can be trimmed to suit application needs
- Optional features
 - Extended paddle arm
 - Stainless steel
 - BSPT threads
 - Sprinkler service (UL & ULC listed)
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 300°F (149°C)
- Maximum operating pressure
 - 300 psi (21 kg/cm²)
 - 1000 psi (70 kg/cm²) – Stainless Steel models



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C NPT	D	E	F	G
4 ⁵ / ₈ (117)	2 ⁵ / ₁₆ (59)	1/2 (25)	1 ³ / ₄ (45)	13 ³ / ₄ (350)	7 ¹ / ₄ (184)	3 ²⁵ / ₃₂ (96)
H	J	K	L	M NPT	N	
2 ⁷ / ₁₆ (62)	1 ¹⁵ / ₁₆ (24)	3 ⁷ / ₁₆ (87)	2 ⁵ / ₈ (67)	1 ¹ / ₄ (32)	9 ¹¹ / ₁₆ (246.6)	

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	No Flow gpm (lpm)	
1¼ (32)	Factory or Minimum	4.8 (18.2)	3 (11.4)	47
	Maximum	7.7 (29.1)	5.9 (22.3)	
1½ (40)	Factory or Minimum	6.3 (23.8)	3.6 (13.6)	63
	Maximum	10 (37.9)	7 (26.5)	
2 (50)	Factory or Minimum	9.9 (37.5)	5.9 (22.3)	105
	Maximum	15.8 (59.8)	11 (41.6)	
2½ (65)	Factory or Minimum	15.3 (57.9)	9.5 (36)	149
	Maximum	23.7 (89.7)	17 (64.3)	
3 (80)	Factory or Minimum	24.4 (92.4)	15.4 (58.3)	230
	Maximum	35.5 (134.4)	29.2 (110.5)	
4 (100)	Factory or Minimum	33.3 (126)	21.1 (79.9)	397
	Maximum	61.4 (232.4)	37.7 (142.7)	
5 (125)	Factory or Minimum	44.4 (168.1)	31 (117.3)	654
	Maximum	84 (317.9)	51 (193)	
6 (150)	Factory or Minimum	56.3 (213.1)	48.7 (184.3)	900
	Maximum	114.8 (434.5)	71 (270.6)	
8 (200)*	Factory or Minimum	104 (393.6)	89 (336.9)	1,500
	Maximum	210 (794.9)	131 (495.8)	
10 (250)*	Factory or Minimum	184 (696.4)	157 (594.2)	2,500
	Maximum	369 (1397)	231 (874.3)	
12 (300)*	Factory or Minimum	289 (1094)	247 (934.9)	3,500
	Maximum	582 (2203)	363 (1374)	
14 (355)*	Factory or Minimum	387 (1465)	323 (1223)	4,000
	Maximum	753 (2850)	495 (1874)	
16 (405)*	Factory or Minimum	513 (1942)	428 (1620)	5,000
	Maximum	998 (3777)	656 (2483)	

Values are ± 10%

* Equipped with a 6" (152mm) paddle

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS7-4E	120100	Industrial flow switch NEMA 7 & 9 rated	12.3 (5.6)
FS7-4EJ	120135	FS7-4E w/BSPT threads	12.7 (5.8)
FS7-4EL	120150	FS7-4E w/extended paddle arm	12.3 (5.6)
FS7-4ELJ	120158	FS7-4EL w/BSPT threads	12.7 (5.8)
FS7-4SE	120175	FS7-4E w/Stainless steel	11.7 (5.3)
FS7-4SEJ	120186	FS7-4EJ w/BSPT threads	12.0 (5.4)

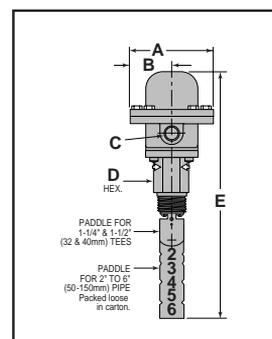
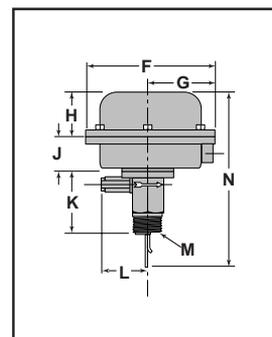
NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Flow Switches – Liquid (continued)

Series FS7-4W

Industrial Liquid Flow Switches

- For applications requiring a water-tight, dust-tight or a **NEMA 4X** rated flow switch
- 1 1/4" (32mm) NPT
- Brass with sealed tube construction
- Single pole, double throw snap switch
- Magnetic switching mechanism eliminates need for bellows
- Sensitivity adjusting screw makes flow adjustment easy
- Paddles can be trimmed to suit application needs
- Optional features
 - Extended paddle arm
 - Stainless steel
 - BSPT threads
- Minimum temperature (fluid or ambient) -65°F (-54°C)
- Maximum temperature 300°F (149°C)
- Maximum operating pressure
 - 300 psi (21 kg/cm²)
 - 1000 psi (70 kg/cm²) – Stainless Steel models



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C NPT	D	E	F	G
4 5/8 (117)	2 5/16 (59)	1/2 (25)	1 3/4 (45)	13 3/4 (350)	7 1/4 (184)	3 25/32 (96)
H	J	K	L	M NPT	N	
2 7/16 (62)	1 5/16 (24)	3 7/16 (87)	2 5/8 (67)	1 1/4 (32)	9 1/16 (246.6)	

Flow Rates

Pipe Size NPT in. (mm)	Settings	Mode of Operation		Max. Flow Rate (GPM) w/o Paddle Damage
		Flow gpm (lpm)	No Flow gpm (lpm)	
1¼ (32)	Factory or Minimum	4.8 (18.2)	3 (11.4)	47
	Maximum	7.7 (29.1)	5.9 (22.3)	
1½ (40)	Factory or Minimum	6.3 (23.8)	3.6 (13.6)	63
	Maximum	10 (37.9)	7 (26.5)	
2 (50)	Factory or Minimum	9.9 (37.5)	5.9 (22.3)	105
	Maximum	15.8 (59.8)	11 (41.6)	
2½ (65)	Factory or Minimum	15.3 (57.9)	9.5 (36)	149
	Maximum	23.7 (89.7)	17 (64.3)	
3 (80)	Factory or Minimum	24.4 (92.4)	15.4 (58.3)	230
	Maximum	35.5 (134.4)	29.2 (110.5)	
4 (100)	Factory or Minimum	33.3 (126)	21.1 (79.9)	397
	Maximum	61.4 (232.4)	37.7 (142.7)	
5 (125)	Factory or Minimum	44.4 (168.1)	31 (117.3)	654
	Maximum	84 (317.9)	51 (193)	
6 (150)	Factory or Minimum	56.3 (213.1)	48.7 (184.3)	900
	Maximum	114.8 (434.5)	71 (270.6)	
8 (200)*	Factory or Minimum	104 (393.6)	89 (336.9)	1,500
	Maximum	210 (794.9)	131 (495.8)	
10 (250)*	Factory or Minimum	184 (696.4)	157 (594.2)	2,500
	Maximum	369 (1397)	231 (874.3)	
12 (300)*	Factory or Minimum	289 (1094)	247 (934.9)	3,500
	Maximum	582 (2203)	363 (1374)	
14 (355)*	Factory or Minimum	387 (1465)	323 (1223)	4,000
	Maximum	753 (2850)	495 (1874)	
16 (405)*	Factory or Minimum	513 (1942)	428 (1620)	5,000
	Maximum	998 (3777)	656 (2483)	

Values are ± 10%

* Equipped with a 6" (152mm) paddle

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
FS7-4W	120201	Industrial flow switch	12.3 (5.6)
FS7-4SW	120191	FS7-4W w/Stainless steel	11.7 (5.3)
FS7-4SWJ	120197	FS7-4SW w/BSPT threads	11.7 (5.3)
FS7-4WJ	120261	FS7-4W w/BSPT threads	12.3 (5.6)
FS7-4WL	120301	FS7-4W w/extended paddle arm	12.7 (5.8)
FS7-4WLJ	120361	FS7-4WL w/BSPT threads	12.7 (5.8)

NOTE: DO NOT USE LIQUID FLOW SWITCHES ON SYSTEMS WITH FLOW GREATER THAN 10 FEET (3M) PER SECOND.

Air Flow Switches

McDonnell & Miller Air Flow Switches sense air flow or no air flow by responding only to velocity of air movement. They provide a positive and economical way to detect change or loss of air flow velocity caused by closed damper or fan inlet, a loose fan wheel, a slipped or broken fanbelt, a dirty or clogged filter, or an overload on a fan motor switch.

The Series AF1 flow switches are designed for medium and higher velocity systems. Models AF2 and AF3 are for systems with lower air flow velocities.

Air flow switches can be used for a variety of applications such as, but not limited to:

- Clean Room Filter Systems
- Duct Type Heating
- Exhaust Ventilating
- Air Supply System
- Air Treatment Systems

Flow Switches	NEMA Enclosure
All Models	Type 1—General purpose indoor
AFE1	Type 7—Hazardous Location (Class 1—Group C or D) Type 9—Hazardous Location (Class 2—Group E,F or G)

Model AFE1 Flow Switches are Underwriters Laboratories Inc. Listed for use in these hazardous locations:

Class I, Division I, Group C – Atmospheres containing ethylether vapors, ethylene or cyclopropane.

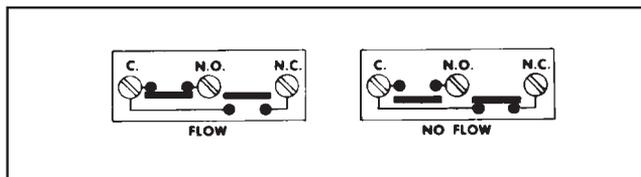
Class I, Division I, Group D – Atmospheres containing gasoline, petroleum, naphtha, benzene, butane, propane, alcohols, acetone, benzol, lacquer solvent vapors or natural gas.

Class II, Division I, Group E – Atmospheres containing dust of aluminum, magnesium or their commercial alloys.

Class II, Division I, Group F – Atmospheres containing carbon black, coal or coke dust.

Class II, Division I, Group G – Atmospheres containing flour, starch or grain dusts.

Note: For other listings contact the factory.



In the tables of flow rates included in this catalog, the word “Flow” means that switch will close one circuit and open the other, when flow rate is increased to the rate shown.

The words “No-Flow” mean the switch will reverse position—open first circuit and close the second—when flow rate is decreased to the rate shown.

How To Select Air Flow Switches

1. What function will the flow switch perform?

McDonnell & Miller Air Flow Switches are equipped with single pole double throw switches; consequently, they can be used to make or break an electrical circuit either when flow starts or when flow stops. For example, the Flow Switch can be used to:

- Actuate a signal when flow stops
- Start a motor with flow
- Shut off an alarm when flow is adequate
- Stop a motor with no flow

2. How much flow is present?

The air flow velocity at which the Air Flow Switch is to respond should be determined first. McDonnell & Miller Air Flow Switches are actuated (make or break) with an increase in velocity and will reverse switch position (break or make) with a decrease in velocity. The term "Flow" represents the actual movement of air (velocity) within a duct sufficient to actuate the switch. The term "No Flow" represents a decrease in velocity or a total air flow stoppage, which will permit the switch to return back to the original position.

IMPORTANT: In operation the switch must be actuated by "Flow" before it can be reversed again by "No-Flow". All McDonnell Flow Switches can easily be adjusted to require a higher actuating "Flow" or "No-Flow".

3. Size of duct

McDonnell & Miller Air Flow Switches are designed for installation in ducts six inches (150mm) and larger.

4. Maximum temperature

Air temperature inside and outside of the duct should be considered. Different McDonnell & Miller Air Flow Switches can be used at temperatures from 32°F (0°C) up to 300°F (149°C).

5. Maximum Velocities

The Series AF1 is designed for medium and higher velocity applications up to 2500 fpm (12.7mps). The Models AF2, AF3, and AF3-D are designed for lower air flow velocities with a maximum of 1445 fpm (7.34mps).

6. Type of air

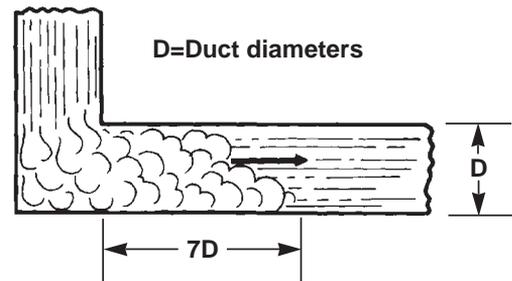
Depending on the model, McDonnell & Miller Air Flow Switches have brass, steel, aluminum, stainless steel, Viton and Teflon® parts exposed to the inside of the duct. In addition to use with normal air, they may be used in applications where certain chemical fumes or other air-borne elements are present.

7. Installation

It is recommended that all models be located in a horizontal duct, 10 duct diameters downstream from fan or 7 duct diameters downstream from an elbow, junction or other cause of turbulence.

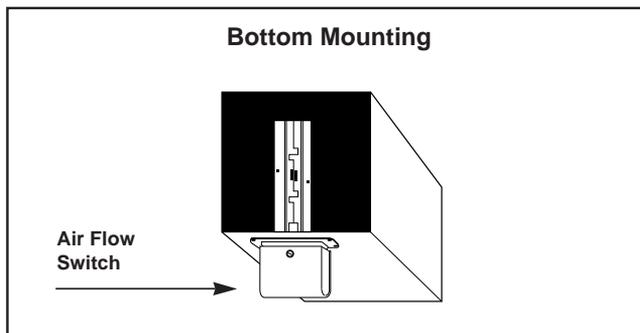
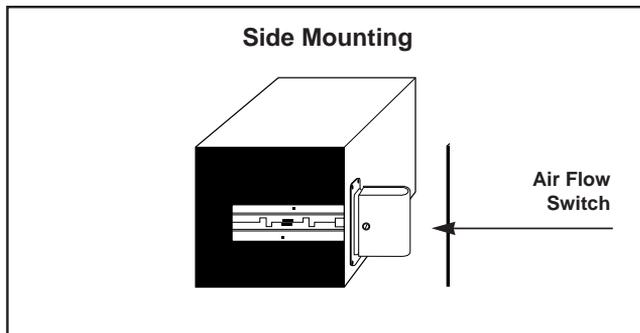
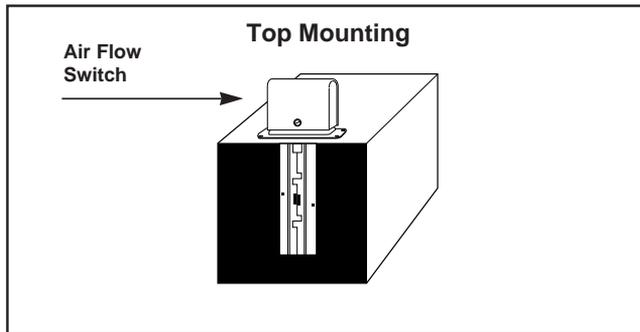
Often the actual flow rates in the duct appreciably exceed the flow rate required to actuate the switch. If the flow switch must be located closer than 10 duct diameters from a fan, it is recommended that the flow switch be installed on the suction side of the fan.

For air flow applications, the air flow switch should be mounted 7 duct diameters downstream of a flow obstruction like an elbow; 10 duct diameters downstream of a blower.



How to Select Air Flow Switches (continued)

Mounting Methods – Horizontal Ducts



Installing the air flow switch in a horizontal duct is recommended. However, if the velocity of air flow exceeds the flow rates shown in the Vertical Duct Chart to the right, the air flow switch may be installed in a vertical duct with **upward** air flow.

IMPORTANT: If the air flow switch must be installed in a vertical duct with **downward** air flow, contact the factory for instructions.

Vertical Duct (Upward Flow)

Model Number	Settings	Mode of Operation	
		Flow fpm (mpm)	No Flow fpm (mpm)
AF1 Standard 7 1/4" (184mm)	Factory or Minimum	910 (277)	785 (239)
	Maximum	1610 (491)	1460 (445)
AF1 Trimmed 2" (51mm) 5 1/4" (133)	Factory or Minimum	1235 (376)	1050 (320)
	Maximum	2560 (780)	2410 (735)
AF3	Factory or Minimum	450 (137)	430 (131)
	Maximum	1470 (448)	1395 (425)
AF3-D	Factory or Minimum	560 (171)	540 (165)
	Maximum	1470 (448)	1030 (314)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
 Values are ± 10%
 Consult factory for downward flow

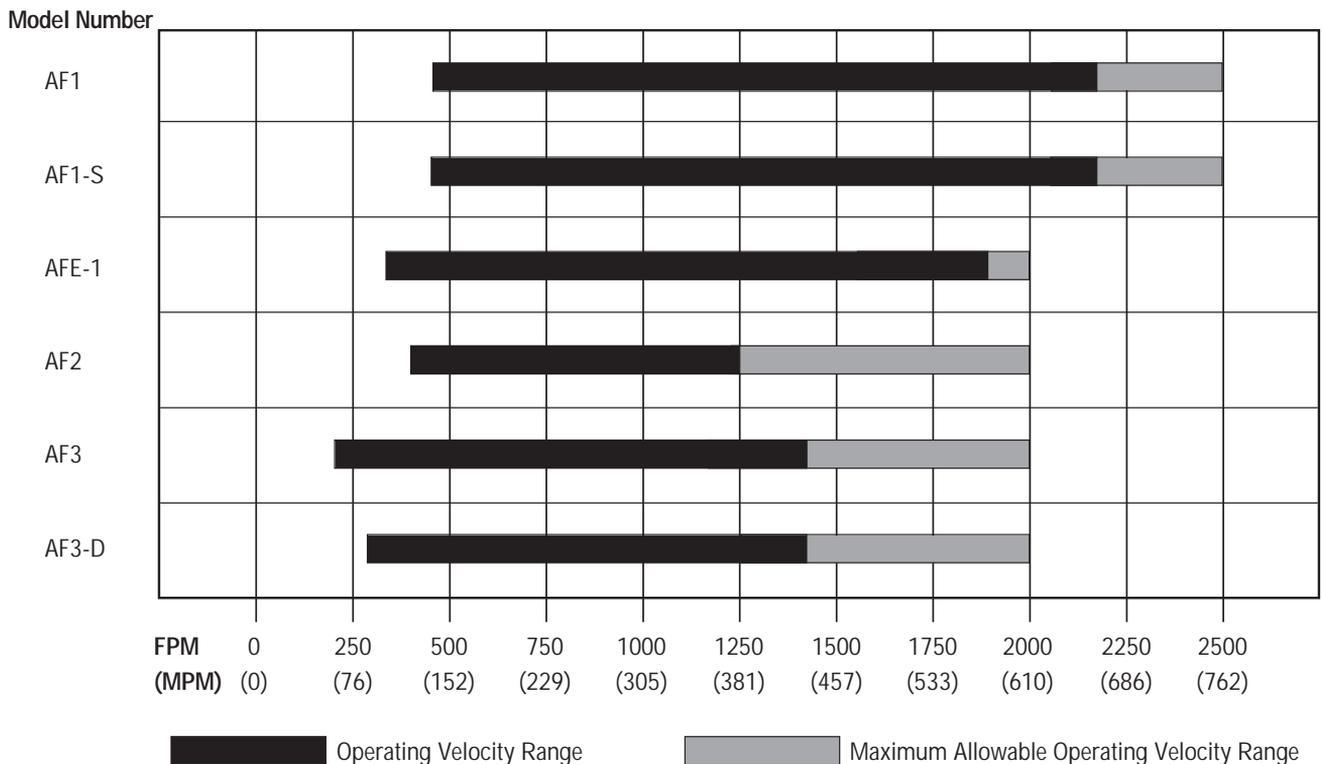
Density of Air as a Function of Temperature

Based on Standard Air			
Temperature		Density	
°F	°C	lbs./ft ³	kg/m ³
-40	-40	.094	1.515
-4	-20	.087	1.395
32	0	.080	1.293
50	10	.078	1.248
68	20	.075	1.205
86	30	.072	1.165
104	40	.070	1.128
140	60	.066	1.060
176	80	.062	1.000
212	100	.059	.946
392	200	.046	.746

Air Flow Switch Specifications – Horizontal Mounting

Model Number	Operating Velocity Range for Horizontal Installation fpm (mpm)	Maximum Allowable Operating Velocity fpm (mpm)	Vane Material	Seal Material	Seal Strength	Enclosure	Switch	Maximum Air Temperature °F (°C)
AF1	480 - 2230 (146 - 680)	2500 (762)	Brass, Steel	Chrome Teflon®	Low	General Purpose Indoor	SPDT	300 (149)
AF1-S	480 - 2230 (146 - 680)	2500 (762)	Stainless Steel 18-8, 302 & 316	Viton	Medium	General Purpose Indoor	SPDT	300 (149)
AFE-1	350-1900 (107 - 579)	2000 (610)	Brass, Stainless Steel, Aluminum	Magnetic Insulation	High	Hazardous Duty Class I & II	SPDT	275 (135)
AF2	380-1250 (116 - 381)	2000 (610)	Brass, Steel, Aluminum	Chrome Teflon®	Low	General Purpose Indoor	SPDT	300 (149)
AF3	235-1445 (72 - 440)	2000 (610)	Brass, Steel, Aluminum	Chrome Teflon®	Low	General Purpose Indoor	SPDT	275 (135)
AF3-D	295-1445 (90 - 440)	2000 (610)	Brass, Steel, Aluminum	Chrome Teflon®	Low	General Purpose Indoor	DPDT	275 (135)

Flow Velocities

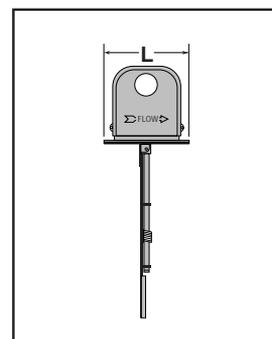
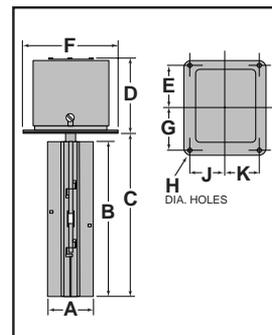


Flow Switches – Air

Series AF1 Air Flow Switches



- For general purpose applications with medium and high velocity requirements
- Paddle fits 8" (203mm) minimum duct size, or 6" (152mm) if trimmed
- Brass, steel and aluminum construction
- Single pole, double throw snap switch
- Sensitivity adjusting screw makes flow adjustment easy
- Two electrical knock-outs allow connection from either end
- Can be equipped with a time delay relay
- Optional features
 - Stainless steel
 - Anti-corrosion treatment
- Minimum temperature (fluid or ambient) 32°F (0°C)
- Maximum temperature 300°F (149°C)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E	F
2 ¹ / ₈ (54)	7 ⁵ / ₁₆ (186)	7 ²³ / ₃₂ (196)	3 ⁷ / ₁₆ (16)	1 ²⁹ / ₃₂ (48.4)	4 ³ / ₈ (111)
G	H	J	K	L	
1 ²⁹ / ₃₂ (48.4)	9 ¹ / ₃₂ (4.2)	1 ¹⁹ / ₃₂ (40.5)	1 ¹⁹ / ₃₂ (40.5)	3 ¹³ / ₁₆ (48.4)	

Flow Rates – feet per minute (meters per minute)

Horizontal Duct (Recommended Installation)

Paddle Length	Settings	Mode of Operation	
		Flow fpm (mpm)	No Flow fpm (mpm)
Standard 7 ¹ / ₄ " (184mm)	Factory or Minimum	480 (146)	185 (56)
	Maximum	1385 (422)	1160 (354)
Trimmed 2" (51mm) 5 ¹ / ₄ " (133mm)	Factory or Minimum	700 (213)	220 (67)
	Maximum	2230 (680)	1820 (555)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
Values are ± 10%

Vertical Duct (Upward Flow)

Paddle Length	Settings	Mode of Operation	
		Flow fpm (mpm)	No Flow fpm (mpm)
Standard 7 ¹ / ₄ " (184mm)	Factory or Minimum	910 (277)	785 (239)
	Maximum	1610 (491)	1460 (445)
Trimmed 2" (51mm) 5 ¹ / ₄ " (133mm)	Factory or Minimum	1235 (376)	1050 (320)
	Maximum	2560 (780)	2410 (735)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
Values are ± 10%
Consult factory for downward flow.

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
AF1	122800	Air flow switch	2.0 (.9)
AF1-S	123000	AF1 w/Stainless steel	2.0 (.9)
AF1-J	122920	AF1 w/anti-corrosion treatment	2.5 (1.1)

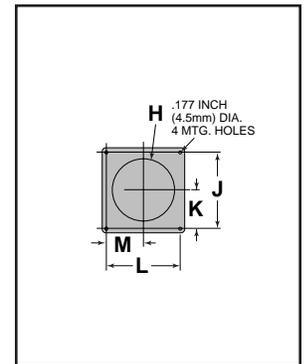
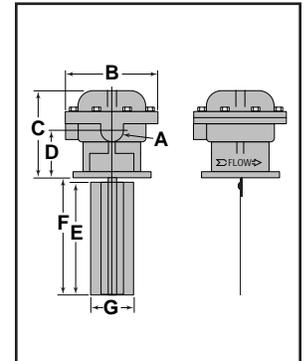
Refer to page 135-136 for time delay relay information.

Flow Switches – Air (continued)

Series AFE-1 Air Flow Switches



- For industrial hazardous environment applications requiring a **NEMA 7 (Class I, Division I, Group C and D) or NEMA 9 (Class II, Division I, Group E, F, and G)** rated flow switch for medium velocity
- 1/2" (15mm) NPT
- Paddle fits 8" (203mm) minimum duct size
- Brass, steel and aluminum construction
- Single pole, double throw snap switch
- Magnetic switching mechanism eliminates need for bellows
- Sensitivity adjusting screw makes flow adjustment easy
- Maximum ambient temperature 120°F (49°C)
- Maximum duct temperature 275°F (135°C)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E	F
1/2 NPT					
1/2 (15)	5 3/4 (146)	5 13/32 (137.3)	2 29/32 (74)	7 1/8 (181)	7 1/2 (191)
G	H	J	K	L	M
2 3/4 (70)	3 5/8 (92)	4 3/8 (111)	2 3/16 (56)	4 3/8 (111)	2 13/16 (56)

Flow Rates – feet per minute (meters per minute)

Horizontal Duct (Recommended Installation)

Mounting/ Duct	Settings	Mode of Operation	
		Flow fpm (mpm)	No Flow fpm (mpm)
Top (Recommended)	Factory or Minimum	300 (91)	100 (30)
	Maximum	1900 (579)	500 (152)
Side	Factory or Minimum	350 (107)	100 (30)
	Maximum	1950 (594)	900 (274)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
 Values are ± 10%

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
AFE-1	123010	Air flow switch NEMA 7 & 9 rated	6 (2.7)

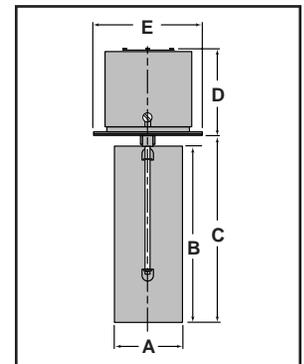
FLOW SWITCHES

Flow Switches – Air (continued)

Series AF2 Air Flow Switches



- For low velocity applications
- Paddle fits 8" (203mm) minimum duct size
- Two electrical knock-outs allow connection from either end
- Brass, steel and aluminum construction
- Single pole, double throw snap switch
- Sensitivity adjusting screw makes flow adjustment easy
- Can be equipped with a time delay relay
- Minimum ambient temperature 32°F (0°C)
- Maximum temperature 300°F (149°C)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E
2 ³ / ₄ (70)	7 ¹ / ₄ (184)	7 ²¹ / ₃₂ (194)	3 ⁷ / ₁₆ (87)	4 ³ / ₈ (111)

Flow Rates – feet per minute (meters per minute) using standard paddle

Horizontal Duct

Settings	Mode of Operation	
	Flow fpm (mpm)	No Flow fpm (mpm)
Factory or Minimum	380 (115)	210 (63)
Maximum	1250 (380)	1000 (304)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
Values are ± 10%

Ordering Information

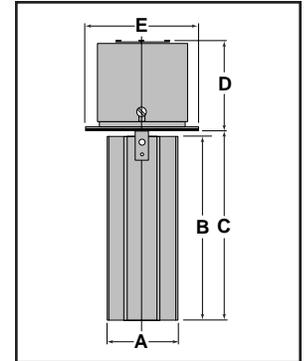
Model Number	Part Number	Description	Weight lbs. (kg)
AF2	123200	Low velocity air flow switch	6 (2.7)

Flow Switches – Air

Series AF3 Air Flow Switches



- For general purpose low velocity applications where the most economical flow switch is desired
- Paddle fits 8" (203mm) minimum duct size
- Two electrical knock-outs allow connection from either end
- Brass, steel and aluminum construction
- Single pole, double throw snap switch
- Sensitivity adjusting screw makes flow adjustment easy
- Can be equipped with a time delay relay
- Optional feature
 - Two SPDT snap switches
- Minimum ambient temperature 32°F (0°C)
- Maximum temperature 275°F (135°C)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC 50 or 60 cycles
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E
2 ³ / ₄ (70)	7 ¹ / ₈ (181)	7 ¹¹ / ₃₂ (186.5)	3 ⁷ / ₁₆ (87)	4 ³ / ₈ (111)

Flow Switches – Air (continued)

Series AF3 (continued)

Air Flow Switches

Flow Rates – feet per minute (meters per minute) using standard paddle

Horizontal Duct (Recommended Installation)

Model Number	Settings	Mode of Operation	
		Flow fpm (mpm)	No Flow fpm (mpm)
AF3	Factory or Minimum	235 (72)	175 (53)
	Maximum	1445 (440)	1365 (416)
AF3-D	Factory or Minimum	295 (90)	220 (67)
	Maximum	1445 (440)	1000 (305)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
 Values are ± 10%

Vertical Duct (Upward Flow)

Model Number	Settings	Mode of Operation	
		Flow fpm (mpm)	No Flow fpm (mpm)
AF3	Factory or Minimum	450 (137)	430 (131)
	Maximum	1470 (448)	1395 (425)
AF3-D	Factory or Minimum	560 (171)	540 (165)
	Maximum	1470 (448)	1030 (314)

Based on Standard Air 0.075 pounds per Cubic Foot (1.205 kg/m³)
 Values are ± 10%

Consult factory for downward flow

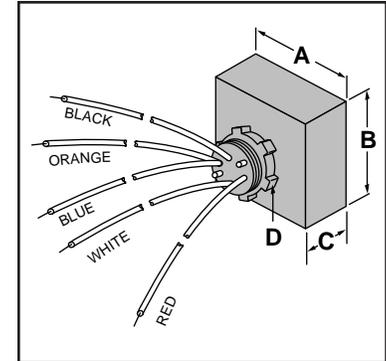
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
AF3	123200	Low velocity air flow switch	1.7 (.77)
AF3-D	123450	AF3 w/2 SPDT switches	2.0 (.9)

Flow Switches – Time Delay Relays

Series T5R Time Delay Relay

- For Series FS1, FS4-3, FS6, FS7-4 and FS8-W liquid flow switches and Series AF2 and AF3 air flow switches, to add time delay function
- Provides **5 second delay on break** (opening) circuit
- Permits intermittent switching of controlled equipment
- Eliminates false signals and rapid cycling from turbulence or fluctuations
- Direct mounting on Series FS4-3, AF2 and AF3
- Remote mounting on main control panel or conduit box with Series FS1, FS6, FS7-4 and FS8-W
- 120 VAC
- 1/2" (15mm) NPT lock nut
- 10" (254mm) lead wires
- Solid state
- Completely encapsulated
- Minimum current 20ma
- Optional feature–24 Volt



Electrical Ratings

Model Number	Switch Rating	
	Input Voltage	Maximum Amperes
T5R	120 VAC	1
T5R-24V	24 VAC	1

Dimensions, in. (mm)

A	B	C	D
1 5/8 (41)	1 3/4 (45)	3/4 (19)	1/2 (15)

Ordering Information

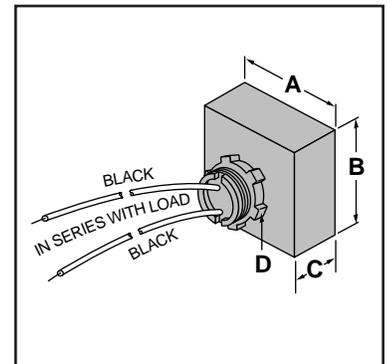
Model Number	Part Number	Description	Weight lbs. (kg)
T5R-120V	112000	Time delay relay	.3 (.1)
T5R-24V	112005	T5R w/24 volt	.3 (.1)

Flow Switches – Time Delay Relays (continued)

Series T20 Time Delay Relay



- For Series FS1, FS4-3, FS6, FS7-4 and FS8-W liquid flow switches and Series AF2 and AF3 air flow switches, to add time delay function
- Provides **20 second delay on make** (closing) circuit
- Permits intermittent switching of controlled equipment
- Eliminates false signals and rapid cycling from turbulence or fluctuations
- Direct mounting on Series FS4-3, AF2 and AF3
- Remote mounting on main control panel or conduit box with Series FS1, FS6, FS7-4 and FS8-W
- 120 VAC
- 1/2" (15mm) NPT lock nut
- 10" (254mm) lead wires
- Solid state
- No polarity
- Completely encapsulated
- Optional features
 - 24 Volt AC
 - 24 Volt DC
- Minimum current 20 ma



Electrical Ratings

Model Number	Switch Rating	
	Input Voltage	Maximum Amperes
T20	120 VAC	1 AC
T20-24V	24 VAC	1 AC
T20-24VDC	24 VDC	1 DC

Note: 20 milliamperes minimum

Dimensions, in. (mm)

A	B	C	D
1 ⁵ / ₈ (41)	1 ³ / ₄ (45)	3/4 (19)	1/2 (15)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
T20-120V	112050	Time delay relay	.3 (.1)
T20-24V	112055	T20 w/24 volt AC	.3 (.1)
T20-24VDC	112060	T20 w/24 volt DC	.3 (.1)

How to Select Liquid Level Controls

McDonnell & Miller offers a comprehensive line of liquid level controls. There are 7 basic models available as float operated, conductance, and pneumatic modulating.

Float operated controls have mercury or snap switch control. Used to guard against low or high levels, or to start and stop auxiliary devices. Available three ways: with one switch for low water cut-off; with two switches to add pump control; or three switches to add high level alarm. Provides up to six operating level functions, wide adjustment, precise field settings.

Conductance actuated controls, utilize probes and the conductivity of the liquid itself to sense levels. Single probe controls for low or high level alarm or cut-off; multi-probe controls for starting and stopping auxiliary equipment between several levels. For tight quarters, or underground tanks, control can be mounted remote from sensor. Models differ in the secondary voltage supplied to the electrode and input sensitivity.

Pneumatic modulating controls, when used with a pneumatically operated control valve will maintain the liquid level in a tank or pressure vessel. They function by modulating the air pressure supplied to the control valve. Pneumatic controls improve system efficiency by adjusting the feed or discharge rate to match the actual demand. thus maintaining levels more precisely Pneumatic controls are particularly well suited for duty in certain hazardous locations since no electrical service is required.

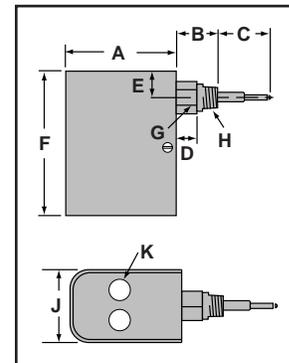
Model Number	Actuation Method	Characteristics
LPC-2000	Conductance	Sensitivity of 60,000 ohms at 12 VAC
PS-850	Conductance	Sensitivity of 3,000 ohms at 14 VAC
VFS	Float Operated	Snap action switch
PCH	Conductance	Sensitivity of 4,000 ohms at 120 VAC
PCL	Conductance	Sensitivity of 60,00 ohms at 28 VAC
PFC	Pneumatic Modulating Float	1-2" Operating range

Conductance Actuated – Probe Type

Series PS-850

Special Purpose Liquid Level Controls

- For residential, commercial and industrial hot water boilers
- Electronic operation
- LED low water indicator light
- Test switch and LED indicator light
- Optional manual reset switch available
- No lock out with loss of power (if probe is in water)
- No blow down required
- No moving parts
- Voltage across probe to ground 14 VAC
- Probe sensitivity 3,500 ohms at 120 or 24 VAC supply
- Power consumption 3 VA
- Meets ANSI specification Z21.13a - Model PS-852
- Maximum ambient temperature 120°F (49°C)
- Maximum water pressure 160 psi (11.2 kg/cm²)
- Maximum water temperature 250°F (121°C)



Electrical Ratings

Model	Voltage	Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
PS-852	24 VAC	—	—	50 VA at 24 VAC
PS-851	120 VAC 240 VAC	7.5 3.75	43.2 21.6	125 VA at 120 or 240 VAC 50 or 60 Hz

Dimensions, in. (mm)

A	B	C	D	E	F	G	H NPT	J	K
4 ¹ / ₄ (108)	1 ⁹ / ₁₆ (40)	1 ⁵ / ₈ (41)	3 ³ / ₄ (19)	1 ³ / ₁₆ (21)	5 ¹³ / ₁₆ (148)	1 ³ / ₈ (35)	3 ³ / ₄ (20)	2 ⁷ / ₈ (73)	7 ⁷ / ₈ (22)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
PS-851-120	153895	LWCO 120V	2.7 (1.2)
PS-851-M-120	153896	PS-851-120 w/manual reset	2.7 (1.2)
PS-852-24	153919	LWCO 24V	2.7 (1.2)
PS-852-M-24	153918	PS-852-24 w/manual reset	2.7 (1.2)

CAUTION

Do not use “manual reset” models with automatic water feeders. Failure to follow this caution can cause flooding and property damage.

Conductance Actuated – Probe Type

Series LPC-2000 General Purpose Liquid Level Controls

- Industrial and commercial level sensing and pump control of cooling towers, tanks, water fountains, condensate units, and others.
- Digital technology utilizing a micro-controller
- Field selectable control unit allows for single or multi-level sensing
- Directly switches a 1 HP motor
- 1 to 4 operating modes:
 - Low Level Alarm
 - High Level Alarm
 - Pump-On
 - Pump-Off
- Compact size
- Time delay feature prevents process disturbances from water level surges
- One control unit for many applications makes selection and stocking easy
- Panel mounting capability for easy installation

Specifications

Control Unit:

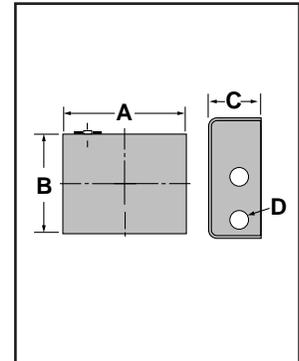
NEMA 1 Enclosure, UL listed
Ambient Temperature 120°F (49°C)
Power Consumption 4 VA
Probe Sensitivity 60,000 ohms

Series-RS High Pressure Remote Sensor:

NEMA 1 Enclosure
Maximum Temperature 406°F (208°C)
Maximum Pressure 250 psig (17.6 kg/cm)

Series-AS Ambient Remote Sensor:

NEMA 1 Enclosure
Maximum Temperature 120°F (49°C)
Maximum Pressure 0 psig



Dimensions, in. (mm) Control Unit

Model	A	B	C	D
LPC-2000	6 ³ / ₈ (162)	5 ¹ / ₈ (130)	2 ⁹ / ₁₆ (65)	7 ¹ / ₈ (22)

Electrical Ratings

Supply Voltage	Probe Voltage	Pump Switch (Amperes)		Load Switching	
		Full Load	Locked Rotor	Alarms	Pump
120 VAC 50/60 Hz	12 VAC	16	96	360 VA at 120 VAC	1HP at 120 VAC

Ordering Information

How To Order

1. Order control unit LPC-2000.
2. Select and order an appropriate remote sensor, based on the number of levels to be sensed.
3. Order the number of probes necessary (1 to 5), in the appropriate lengths, as required for your application.

Conductance Actuated – Probe Type

Series LPC-2000 (continued) General Purpose Liquid Level Controls

Remote Sensors

Model	A	B	C
RS-1-BR-1	1 (25) NPT	1 ¹¹ / ₁₆ (43)	½ (15) NPT
RS-2-BR-1	2 (50) NPT	2 ¹¹ / ₃₂ (59.5)	½ (15) NPT
RS-3-BR-1	2½ (65) NPT	2 ¹⁵ / ₃₂ (63)	½ (15) NPT
AS-5S	IS07-R02	3 ⁵ / ₈ (92)	1 ¹ / ₃₂ (26)

Model	D	E	F
RS-1-BR-1	4 ⁹ / ₁₆ (116)	1¼ (32)	3¼ (83)
RS-2-BR-1	3 ⁷ / ₈ (98)	4 (102)	–
RS-3-BR-1	4 (102)	4 (102)	–
AS-5S	2 ³ / ₈ (60)	3 ⁵ / ₃₂ (80)	3 ⁵ / ₃₂ (80)

Control Unit

Model Number	Part Number	Description	Weight lbs. (kg)
LPC-2000	176217	Control unit	2.7 (1.2)

High Pressure Remote Sensors and Probes

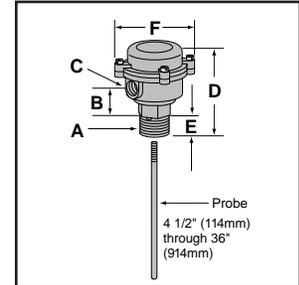
Model Number	Part Number	Description	Weight lbs. (kg)
RS-1-BR-1	179524	Remote sensor; 1 level	1.7 (.8)
RS-2-BR-1	179525	Remote sensor; 2 levels	3.3 (1.5)
RS-3-BR-1	179526	Remote sensor; 3 levels	3.3 (1.5)
RS-4-BR-1	179527	Remote sensor; 4 levels	4.0 (1.8)
RS-5-BR-1	179528	Remote sensor; 4 levels for non-metallic tanks	4.3 (1.95)
G-2-SS	179156	24" (610mm) SS Ground Probe	1.0 (.5)
G-3-SS	179157	36" (914mm) SS Ground Probe	1.5 (.7)
G-4-SS	179158	48" (1219mm) SS Ground Probe	2.0 (.9)
G-5-SS	179159	60" (1524mm) SS Ground Probe	2.5 (1.1)
G-6-SS	179160	72" (1829mm) SS Ground Probe	3.0 (1.4)
P-1/3-SS	176208	4½" (114mm) Probe	0.5 (.23)
P-1-SS	179530	12" (305mm) SS Probe	0.5 (.23)
P-2-SS	179535	24" (610mm) SS Probe w/Teflon®	1.0 (.5)
P-3-SS	179540	36" (914mm) SS Probe w/Teflon®	1.5 (.7)
P-4-SS	179545	48" (1219mm) SS Probe w/Teflon®	2.0 (.9)
P-5-SS	179550	60" (1524mm) SS Probe w/Teflon®	2.5 (1.1)
P-6-SS	179555	72" (1829mm) SS Probe w/Teflon®	3.0 (1.4)

Ambient Pressure Remote Sensors and Probes

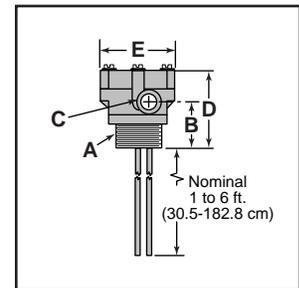
Model Number	Part Number	Description	Weight lbs. (kg)
AS-5S	176230	Remote sensor: 4 levels for all tanks	.5 (.23)
AP-3-SS-J	176231	39" (991mm) SS Ambient Probe	1.0 (.5)



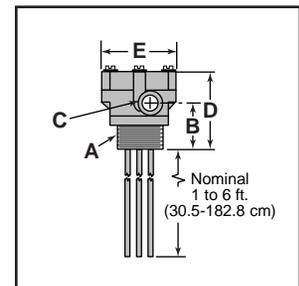
High Pressure Remote Sensor Model RS-1-BR-1



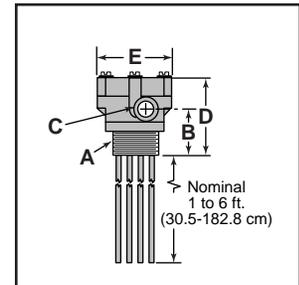
High Pressure Remote Sensor Model RS-2-BR-1



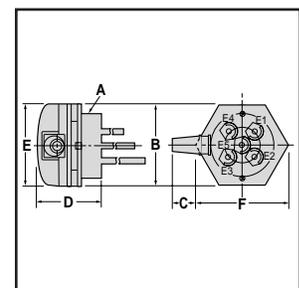
High Pressure Remote Sensor Model RS-3-BR-1



High Pressure Remote Sensor Model RS-4-BR-1 Model RS-5-BR-1



Ambient Pressure Remote Sensor AS-5S

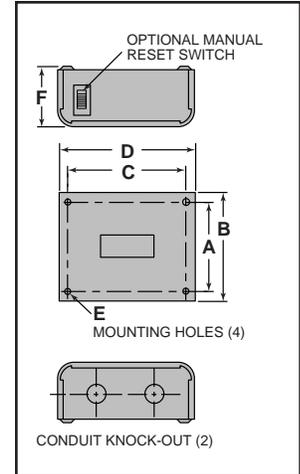


LIQUID LEVEL CONTROLS

Conductance Actuated – Probe Type (continued)

Series PCH & PCL General Purpose Liquid Level Controls

- For sophisticated multi-level control in tanks, boilers and hydronic systems
- Electronic circuitry with remote conductance probe level sensing:
 - Series PCH probe sensitivity - 4,000 ohms at 120 VAC for boiler water and most common liquid
 - Series PCL probe sensitivity - 60,000 ohms at 28 VAC for commercial distilled water and solutions
- Teflon® coated probes provide protection from false signals [available on 24 - 72" (610 - 1829mm) probes]
- No blow down required
- Current limiting device provided
- Probe lengths 12 - 72" (305 - 1829mm) in 12" (2.5cm) increments
- Remote sensors accommodate 1 - 3 probes
- Control enclosures are NEMA 1 rated and remote sensors are NEMA 4 rated
- Optional features
 - Manual reset switch
 - Alternate pump switch
 - 28 Volt probe – Series PCL; 120 Volt probe – Series PCH
- Maximum ambient temperature 120°F (49°C)
- Maximum water temperature 406°F (208°C)
- Maximum pressure 250 psig (17.6 kg/cm²)



Electrical Ratings

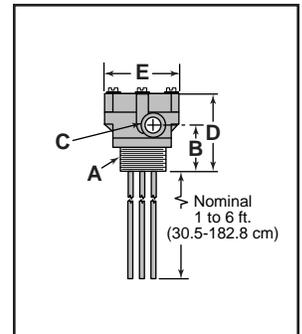
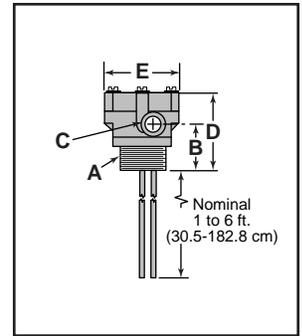
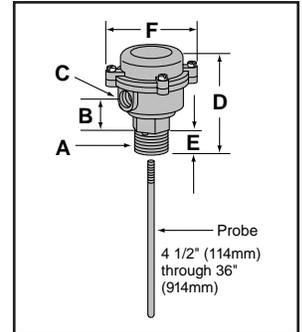
Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	360 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

Control Unit	A	B	C	D	E	F
1 & 2 level	4 ³ / ₁₆ (106)	5 ¹ / ₈ (130)	5 ¹ / ₂ (140)	6 ⁵ / ₈ (168)	5 ⁵ / ₃₂ (4)	2 ³ / ₄ (70)

Conductance Actuated – Probe Type

Series PCH & PCL (continued)
 General Purpose Liquid Level Controls



Dimensions, in. (mm)

Remote Sensor	A	B	C	D	E	F
1 Probe	1 (25) NPT	1 ¹¹ / ₁₆ (43)	1/2 (15) NPT	4 ⁹ / ₁₆ (116)	1 ¹ / ₄ (32)	3 ³ / ₄ (83)
2 or 3 Probes	2 (50) NPT	2 ¹¹ / ₃₂ (59.5)	1/2 (15) NPT	3 ⁷ / ₈ (98)	4 (102)	—

Conductance Actuated – Probe Type (continued)

Series PCH & PCL

Operation

Basically, the control reports the liquid level of the boiler or tank whenever it makes or breaks contact with the pre-positioned probes. The controls have SPDT switch action to provide stop and go operation at every set point. The remote sensors, which thread into the top of the boiler or tank, are available with 1, 2 or 3 probes of varying lengths that can easily be cut to desired set points.

How to Select

1. Determine the level of sensitivity required.
2. Determine the type of switch action required.
3. Determine the nature of what needs to be controlled so that you can choose the model that best suits your needs. Refer to the Ordering Information chart to preview the available models and features.

SERVICE	Open Circuit Probe Voltage	CONTROLS		No. of Electrodes	SENSORS Model No.	PROBES No. & Length	SPACER	GROUND PROBES No. & Length
		Automatic Reset Model No.	Manual Reset Model No.					
1 Level Control Low or High Level Cut-off and/or Signal	125V	PCH-G-A-1 PCH-G-A-1K*	PCH-G-M-1. PCH-G-M-1K*	1	RS-1-BR-1	12" Probe P-1-SS 24" Probe (Teflon coated) P-2-SS 36" Probe (Teflon coated) P-3-SS 48" Probe (Teflon coated) P-4-SS 60" Probe (Teflon coated) P-5-SS 72" Probe (Teflon coated) P-6-SS	Not Used	12" Probe (bare) P-1-SS 24" Probe (bare) P-2-SS 36" Probe (bare) P-3-SS 48" Probe (bare) P-4-SS 60" Probe (bare) P-5-SS 72" Probe (bare) P-6-SS
	28V	PCL-G-A-1	PCL-G-M-1					
2 Level Control Differential Control	125V	PCH-G-A-2		2	RS-2-BR-1	SPACER S-4 Use when 2 or more probes are greater than 3 feet long		
	28V	PCL-G-A-2						

*120 and 240 Volt Switch Ratings

The table above shows the combinations of Controls, Sensors, and Probes available for each type of service. Select Control according to anticipated use, Probe voltage, and the type of reset desired. The Sensor should be selected according to the number of Probes required. The Probes are ordered separately according to length needed. The Control, Sensor and each Probe must be specified separately, using the appropriate catalog numbers.

Series PCH & PCL (continued)
General Purpose Liquid Level Controls

Ordering Information

Control, remote sensor and probe(s) must be ordered separately. Order Spacer S-4 when 2 or more probes greater than 36" (914mm) will be used.

Controls

Model Number	Part Number	Description	Weight lbs. (kg)
PCH-G-A-1	179120	Control; 1 level w/125V for probe	2.7 (1.2)
PCH-G-A-1K	179121	Control; 1 level w/120/240V for probe	2.7 (1.2)
PCH-G-A-2	179150	Control; 2 levels w/125V for probe	2.7 (1.2)
PCH-G-M-1	179130	PCH-G-A-1 w/manual reset	2.7 (1.2)
PCH-G-M-1K	179131	Control; 1 level w/120/240V for probe and manual reset	2.7 (1.2)
PCL-G-A-1	179100	Control; 1 levels w/28V for probe	2.7 (1.2)
PCL-G-A-2	179140	Control; 2 levels w/28V for probe	2.7 (1.2)
PCL-G-M-1	179110	PCL-G-A-1 w/manual reset	3.0 (1.4)

Remote Sensors

Model Number	Part Number	Description	Weight lbs. (kg)
RS-1-BR-1	179524	Remote Sensor; 1 level	1.7 (.8)
RS-2-BR-1	179525	Remote Sensor; 2 levels	3.3 (1.5)
RS-3-BR-1	179526	Remote Sensor; 3 levels	3.3 (1.5)
RS-1-LP	176203	Remote Sensor	3.0 (1.4)

Accessories

Model Number	Part Number	Description	Weight lbs. (kg)
S-4	179529	Spacer	3.0 (1.4)

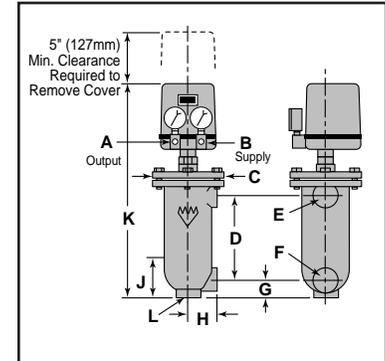
Probes

Model Number	Part Number	Description	Weight lbs. (kg)
G-2-SS	179156	24" (610mm) Ground Probe	1.0 (.5)
G-3-SS	179157	36" (914mm) Ground Probe	1.5 (.7)
G-4-SS	179158	48" (1219mm) Ground Probe	2.0 (.9)
G-5-SS	179159	60" (1524mm) Ground Probe	2.5 (1.1)
G-6-SS	179160	72" (1829mm) Ground Probe	3.0 (1.4)
P-1/3 SS	176208	4 1/2" (114mm) Probe	0.5 (.23)
P-1-SS	179530	12" (305mm) Probe	0.5 (.23)
P-2-SS	176208	24" (610mm) Probe w/Teflon®	1.0 (.5)
P-3-SS	179540	36" (914mm) Probe w/Teflon®	1.5 (.7)
P-4-SS	179545	48" (1219mm) Probe w/Teflon®	2.0 (.9)
P-5-SS	179550	60" (1524mm) Probe w/Teflon®	2.5 (1.1)
P-6-SS	179555	72" (1829mm) Probe w/Teflon®	3.0 (1.4)

Float Actuated Pneumatic

Series PFC Liquid Level Controls

- For the actuation of pneumatic valves or relays in heating, air conditioning and process systems in hazardous or non-hazardous locations
- Provides an air pressure signal proportional to the liquid level
- Available as Direct Acting or Reverse Acting
- A float operated armature senses the liquid level
- Switch mechanism is completely sealed from the liquid
- Two gauges are provided to display the supply and output pressures
- Alternate air connection tappings are provided for greater flexibility in piping
- Operating range: 1 - 2" (25 - 51mm)
- Air pressure
 - Supply 20 psi (1.4 kg/cm²)
 - Output 3 - 15 psi (.2 - 1 kg/cm²)
- Maximum water temperature 406°F (208°C)
- Maximum pressure 250 psig (17.6 kg/cm²)



Dimensions, in. (mm)

A	B	C	D	E	F	G	H	J	K	L
NPT	NPT			NPT	NPT					NPT
1/8 (4)	1/8 (4)	7 (178)	8 (203)	1 (25)	1 (25)	1 3/4 (45)	2 5/8 (67)	4 (102)	20 3/4 (527)	1 (25)

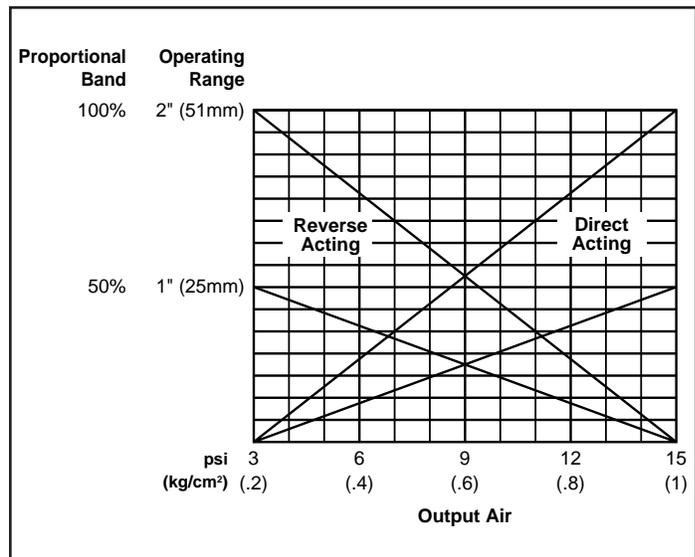
Water Level Adjustment

Model	Type	Level Adjustment Range in. (mm)
PFC-1-G	Direct Acting	1 - 2 (25 - 51)
PFC-1-GR	Reverse Acting	1 - 2 (25 - 51)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
PFC-1-G	180800	Direct acting pneumatic liquid level control	38.5 (17.5)
PFC-1-GR	180801	Reverse acting pneumatic liquid level control	38.5 (17.5)

Output Air

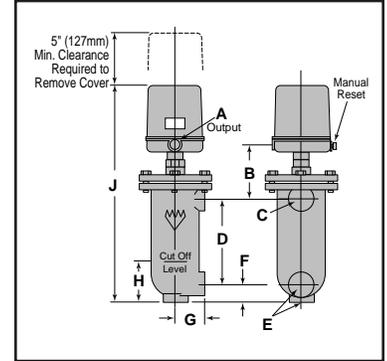


Float Actuated

Series VFS Liquid Level Controls



- General purpose NEMA 1 rated liquid level controls for a variety of industrial and commercial applications such as boilers and tanks, high and low alarms and pumps
- Can be used in pairs to start and stop auxiliary equipment between any desired levels
- 1" (25mm) NPT pipe connection
- 3/4" (20mm) NPT electrical outlet
- Available with snap action switches
- A float operated armature with magnetic switching senses the liquid level
- Switch mechanism is completely sealed from the liquid
- Optional features
 - 2 or 3 switches for actuation of multiple devices
 - Manual reset
- Maximum ambient temperature
 - Series VFS (snap action switch) 110°F (43°C)
- Maximum flooded chamber temperature 360°F (182°C)
- Maximum water temperature 406°F (208°C)
- Maximum pressure 250 psig (17.6 kg/cm²)



Electrical Ratings

No. of switches	Voltage	Motor Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
1 or 2 switches	120 VAC	7.4	44.4	360 VA at 120 or 240 VAC
	240 VAC	3.7	22.2	
3 switches	120 VAC	1.8	—	
	240 VAC	.9	—	
Maximum control rating 2000 VA				

Dimensions, in. (mm)

A	B	C	D	E	F	G	H	J
NPT		NPT		NPT				
3/4 (20)	5 1/8 (130)	1 (25)	8 (203)	1 (25)	1 3/4 (45)	2 5/8 (67)	4 (102)	20 3/4 (527)

Float Actuated

Series VFS Liquid Level Controls

Operating Level Adjustment

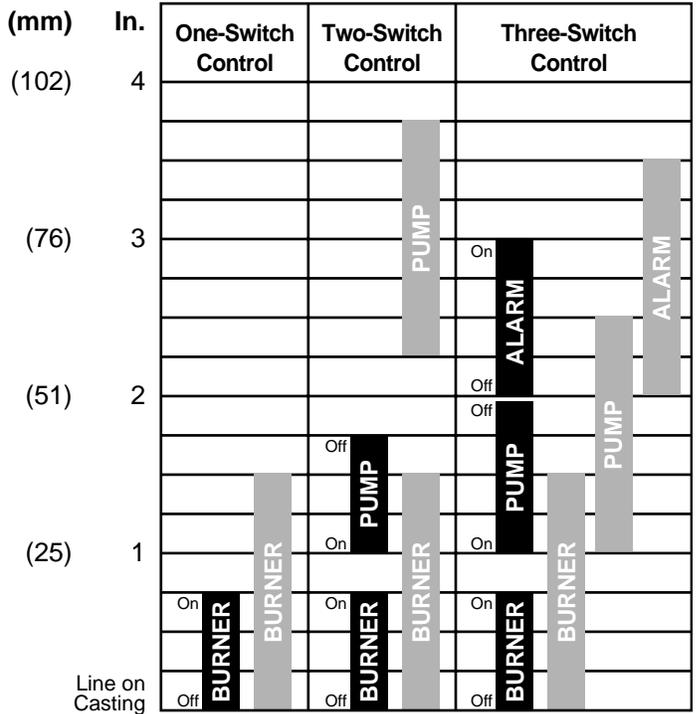
Model Number	Reset Operation	Number of Switches
Snap Switch		
VFS-1A-V	Automatic	One (SPDT)
VFS-1M-V	Manual	
VFS-2A-V	Automatic	Two (SPDT, SPST)
VFS-2M-V	Manual	
VFS-3A-V	Automatic	Three (SPDT, SPST, SPDT)
VFS-3M-V	Manual	

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
VFS-1A-V	180250	Liquid level control w/1 SPDT snap switch	37.0 (16.8)
VFS-1M-V	180240	VFS-1A-V w/manual reset	37.0 (16.8)
VFS-2A-V	180290	Liquid level control w/2 snap switches (1 SPDT & 1 SPST)	37.0 (16.8)
VFS-2M-V	180280	VFS-2A-V w/manual reset	37.0 (16.8)
VFS-3A-V	180330	Liquid level control w/3 snap switches (2 SPDT & 1 SPST)	38.0 (17.2)
VFS-3M-V	180320	VFS-3A-V w/manual reset	38.0 (17.2)

Adjustable Operating Levels

Factory minimum setting shown in black, possible field adjustments shown in gray.



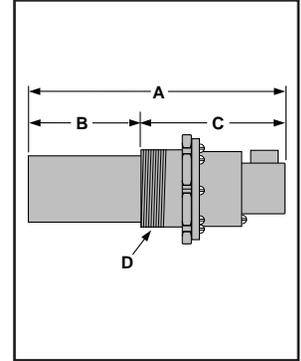
Note: Levels may vary from 1/16 - 3/16" (1.6 - 4.8mm)

Float Actuated – For Fuel Oil

Series E-8 Liquid Level Controls



- For industrial or commercial applications where measuring or regulating Grade 2 fuel oil levels (with a gravity of 0.85 or greater) in storage tanks is required
- Threads directly into 2 1/2" (65) NPT tapping of tank side
- Single pole, double throw switch
- Maximum operating pressure 5 psi (.35 kg/cm²)
- Maximum water temperature 190°F (87°C)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D
8 7/8 (225)	4 1/8 (105)	4 3/4 (121)	2 1/2 (65) NPT

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
E-8	158300	Low water cut-off	3.7 (1.7)
E-8-J	158410	E-8 w/BSPT threads	3.7 (1.7)
E-8 CAN	158302	E-8 w/CSA approval	3.7 (1.7)

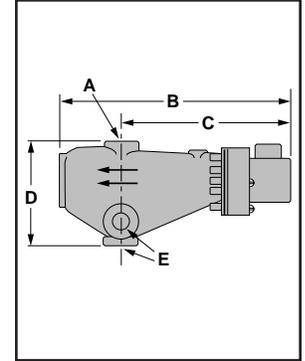
Float Actuated – For Fuel Oil (continued)

Series 80



Liquid Level Controls

- For industrial or commercial applications where measuring or regulating Grade 2 fuel oil levels (with a gravity of 0.85 or greater) in storage tanks is required
- External mounting (with equalizing piping)
- 1/2" (15) NPT tappings provided at top, bottom, and sides of body
- Single pole, double throw switch
- Maximum operating pressure 5 psi (.35 kg/cm²)
- Maximum water temperature 190°F (87°C)



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	125 VA at 120 or 240 VAC
240 VAC	3.7	22.2	

Dimensions, in. (mm)

A	B	C	D	E
NPT				NPT
1/2 (15)	9 1/4 (235)	6 3/4 (171.4)	4 1/4 (108)	1/2 (15)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
80	158100	Low water cut-off	4.5 (2)
80 CAN	158102	80 w/CSA approval	4.5 (2)

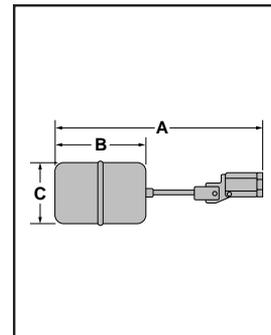
Float Actuated (continued)

Series 18 Liquid Level Controls

- For residential and commercial liquid level applications such as humidifiers and tanks
- Valve opens to full capacity with a small drop of the float
- Maximum supply pressure 100 psi (7 kg/cm²)

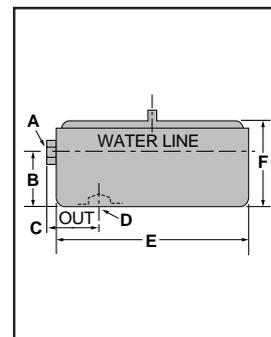
Dimensions, in. (mm)

A	B	C
8 ¹³ / ₁₆ (224)	3 ³ / ₄ (95)	2 ¹⁷ / ₃₂ (64.3)



Model 518 Liquid Level Controls

- Series 18 inside a covered chamber



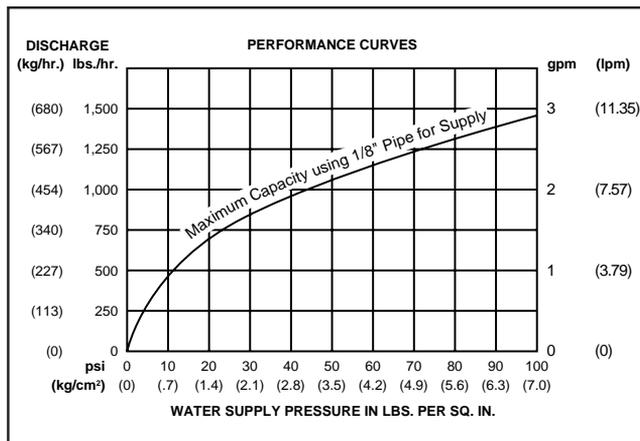
Dimensions, in. (mm)

A NPT	B	C	D NPT	E	F
1/8 (4)	2 1/2 (64)	2 7/16 (62)	1/2 (15)	8 21/32 (220)	3 7/8 (98)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
18	125700	Liquid level control	1 (.5)
118	126000	18 w/float 90° to valve	1.1 (.5)
518	126200	18 w/covered chamber	4 (1.8)

Capacities



LIQUID LEVEL CONTROLS

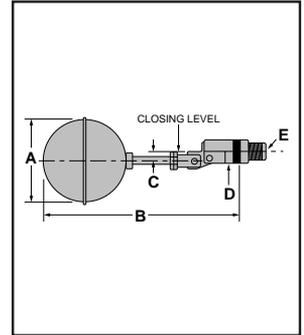
Float Actuated

Series 18-SS Liquid Level Controls

- For commercial and industrial liquid level applications such as pharmaceutical and laboratory, or others that require stainless steel construction
- Materials of construction
 - Type 302, 303 & 304 stainless steel
 - Viton disc, fiber washer
- Maximum supply pressure 100 psi (7 kg/cm²)



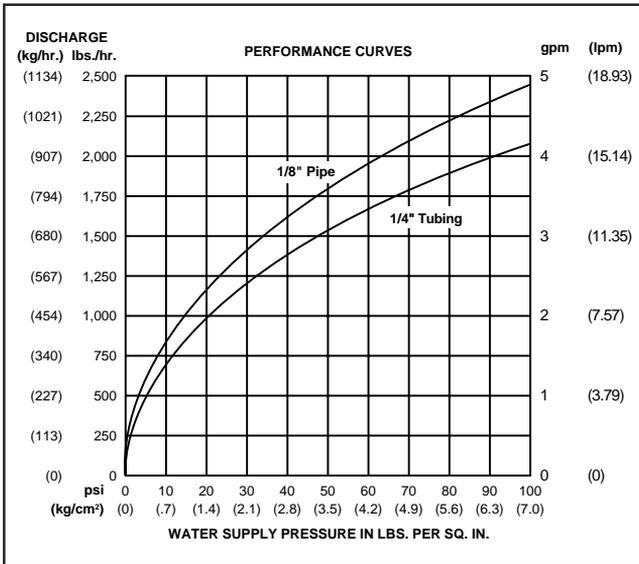
Series 18-SS



Dimensions, in. (mm)

A	B	C	D	E
3 ³ / ₃₂ (78.6)	7 ¹³ / ₁₆ (196)	1 ¹ / ₃₂ (8.7)	7/8 (22) HEX	1/8 (4) NPT

Capacities



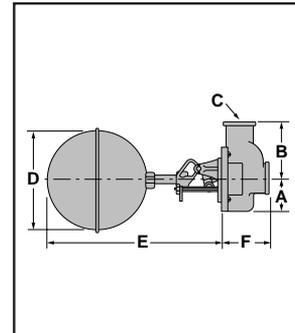
Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
18-SS	125825	Liquid level control w/SS	1 (.5)

Float Actuated (continued)

Series 27-W Liquid Level Controls

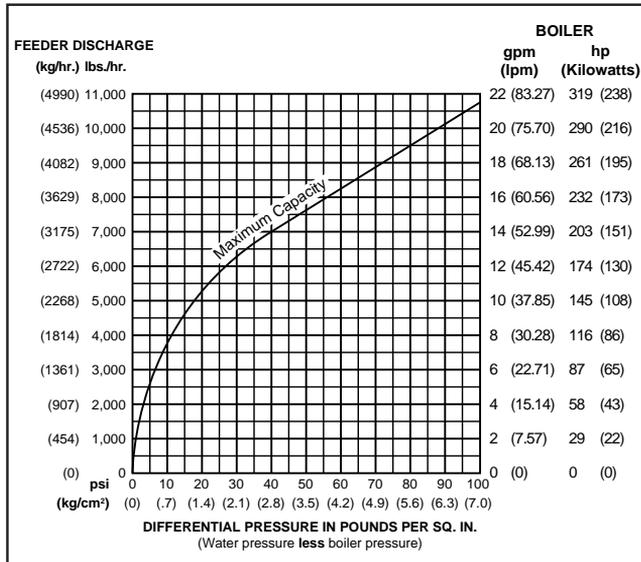
- For commercial and industrial liquid level open tank applications
- Materials of construction
 - Brass
 - Monel valve seat, EPDM disc
- Maximum pressure 35 psi (2.5 kg/cm²)
- Maximum supply pressure 100 psi (7 kg/cm²)
- Minimum liquid temperature 40°F (40°C)
- Maximum liquid temperature 212°F (100°C)



Dimensions, in. (mm)

A	B	C NPT	D	E	F
1 ⁹ / ₁₆ (40)	2 ⁷ / ₈ (73)	3 ⁴ / ₄ (20)	5 (127)	8 ⁵ / ₈ (219)	2 ⁷ / ₁₆ (62)

Capacities



Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
27-W	127200	Liquid level control	5 (2.3)

Float Actuated For Liquid

Series 65

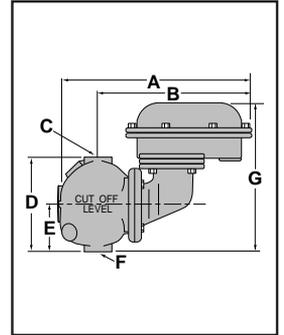


Liquid Level Controls

- For industrial applications where measuring and regulating liquid levels in tanks, receivers, or other liquid storage systems subject to hazardous environments is required
- UL listed for hazardous conditions
 - NEMA 7 Class I, Groups C & D
 - NEMA 9 Class II, Groups E, F & G
- Packless bellows
- Heavy duty single pole, single throw switch
- Available in direct or reverse acting
- Maximum operating pressure 40 psi (2.8 kg/cm²)
- Maximum water temperature 287°F (142°C)

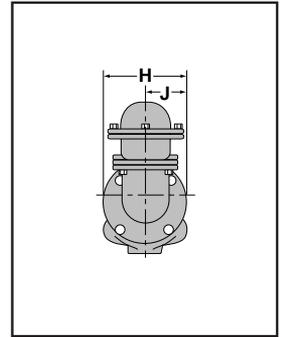


Series 65



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	9.8	58.8	125 VA at 120 or 240 VAC
240 VAC	4.9	29.4	



Dimensions, in. (mm)

A	B	C NPT	D	E	F NPT	G	H	J
13 ³ / ₈ (339)	10 ¹³ / ₁₆ (274)	1 (25)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	1 (25)	10 ³ / ₁₆ (274)	5 (127)	4 ³ / ₄ (121)

Materials of Construction

Part	Specifications
Body	Cast Iron
Bellows	Double-ply Brass
Float	Copper
Float Rod	Stainless Steel

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
65	146700	Low water cut-off hazardous duty	23.5 (11)
65-R	146800	65 w/reverse action	23.5 (11)

Float Actuated (continued) For Liquid

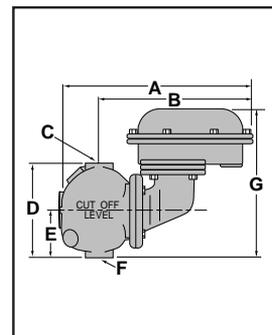
Series 165 Liquid Level Controls



- For industrial applications where measuring and regulating liquid levels in tanks, receivers, or other liquid storage systems subject to outdoor environment or high humidity is required
- NEMA 4X
- Packless bellows
- Heavy duty single pole, single throw switch
- Available in direct or reverse acting
- Maximum operating pressure 50 psi (3.5 kg/cm²)
- Maximum water temperature 287°F (142°C)

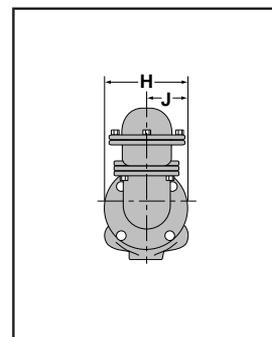


Series 165



Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	9.8	58.8	125 VA at 120 or 240 VAC
240 VAC	4.9	29.4	



Dimensions, in. (mm)

A	B	C NPT	D	E	F NPT	G	H	J
13 ³ / ₈ (339)	10 ¹³ / ₁₆ (274)	1 (25)	6 ¹ / ₂ (165)	3 ¹ / ₈ (79)	1 (25)	10 ³ / ₁₆ (274)	5 (127)	4 ³ / ₄ (121)

Materials of Construction

Part	Specifications
Body	Cast Iron
Bellows	Double-ply Brass
Float	Copper
Float Rod	Stainless Steel

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
165	147100	Low water cut-off vapor proof	22.3 (10)
165-R	147300	165 w/reverse action	22.3 (10)

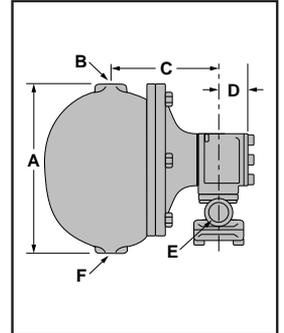
Liquid Level Control Float Actuated

Series 3155 Liquid Level Control

- For medium and large solvent still applications that require a regulator
- High capacity feed
- Not a positive shut-off valve
- Monel bellows
- Stainless steel valve and seat
- Maximum supply pressure 25 psi (1.8 kg/cm²)
- Maximum pressure 15 psi (1 kg/cm²)



Series 3155



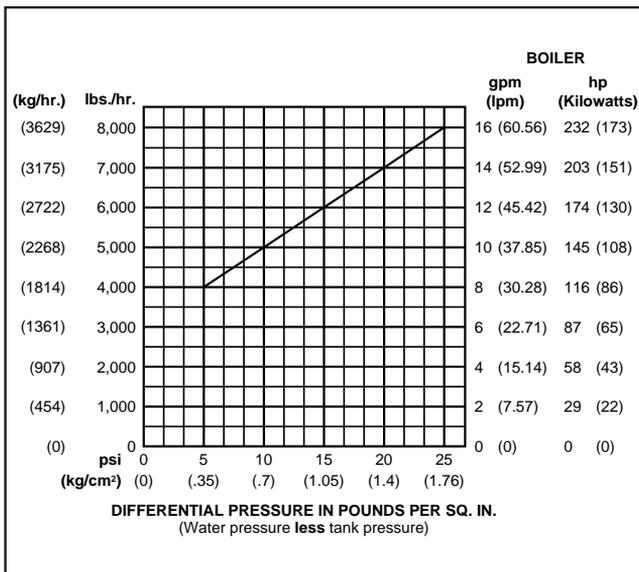
Dimensions, in. (mm)

A	B NPT	C	D	E NPT	F NPT
10 ¹ / ₂ (267)	1 (25)	6 ¹¹ / ₁₆ (170)	2 (51)	1 (25)	1 (25)

Ordering Information

Model Number	Part Number	Description	Weight lbs. (kg)
3155	137700	Regulator	37 (16.8)

Capacities



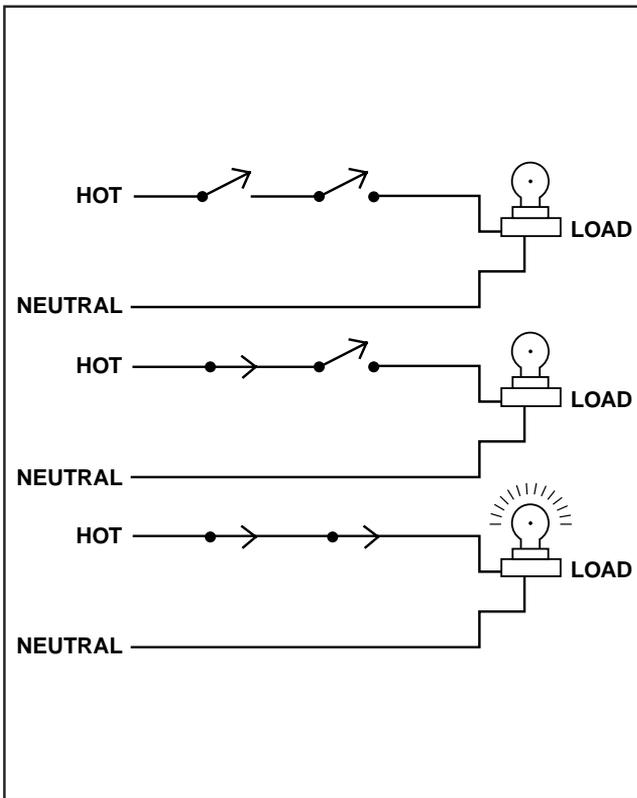
Electrical Circuits

Many McDonnell & Miller products are used to switch electrical circuits, in response to physical parameters such as level and flow. Understanding electrical wiring is necessary to ensure proper installation and operation.

Therefore, we are providing you with this Basic Wiring section as primary information on electric circuits and switches, and how to wire popular McDonnell & Miller products.

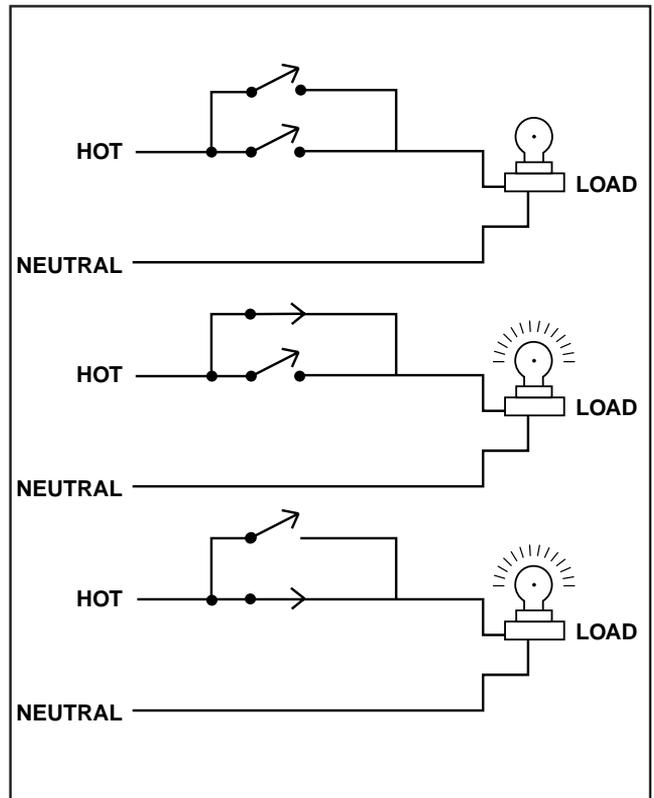
WARNING	
	To prevent an electrical fire, equipment damage, or electrocution, follow electrical wiring instructions, codes and ordinances.
	Failure to follow this warning could cause property damage, personal injury or death.

Series



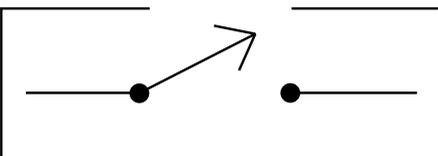
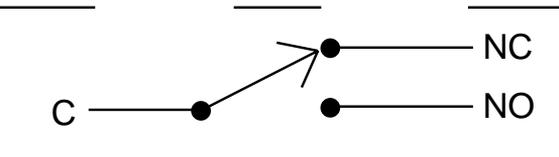
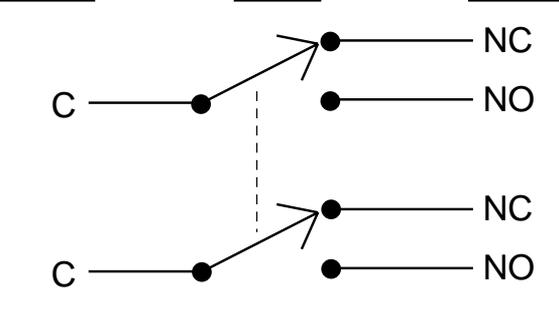
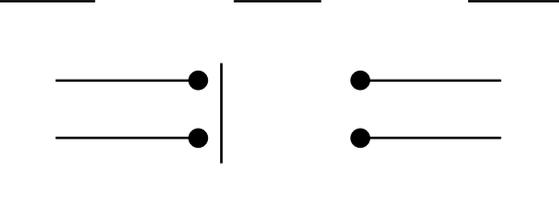
Both closed, circuit closed.
One open, circuit open.

Parallel



One closed, circuit closed.
Both open, circuit open.

Types of Electrical Switches

Type	Description	Where Used
 <p style="text-align: center;">SPST (Single Pole, Single Throw)</p>	<p>Make or break one circuit.</p>	<p>Series 65, 150, 150S & 165 boiler control pump switch Series 11 switch</p>
 <p style="text-align: center;">SPDT (Single Pole, Double Throw)</p>	<p>Make one circuit and break one circuit with common terminal.</p>	<p>Series 2 switch Series 150 boiler control burner switch & alarm All flow switches</p>
 <p style="text-align: center;">DPDT (Double Pole, Double Throw)</p>	<p>Make two circuits and break two circuits with two common terminals.</p>	<p>Series FS7-4D flow switch Series FS4-3D flow switch Series AF3-D flow switch</p>
 <p style="text-align: center;">SPDB (Single Pole, Double Break)</p>	<p>Make one circuit and break one circuit with no common terminals.</p>	<p>Series 5 & 6 switches</p>

Switch Operation

No. 2 Switch
Used on McDonnell No. 47-2, No. 247-2, No. 51-2, No. 51-S-2, No. 53-2 and No. 63

Water level normal. Burner on—alarm off.

Low water level. Burner off—alarm on.

No. 11 Switch
Used on McDonnell No. 67, No. 61 and all "Built-in" type Low Water Cut-offs.

Water level normal. Burner on—electric feed valve or alarm off.

Water level dropped to electric feed valve or alarm operating level. Burner on.

Low water level. Burner off—electric feed valve or alarm on.

Series 150 & 150S Switch
Used on No. 150 and 157 Series.

Boiler feed pump off—burner on—alarm off.

Boiler feed pump on—burner on—alarm off.

Boiler feed pump on—burner off—alarm on.

No. 5 Switch
Used on 93, 193, 94 and 194 Series.

Boiler feed pump off—burner on—alarm off.

Boiler feed pump on—burner on—alarm off.

Boiler feed pump on—burner off—alarm on.

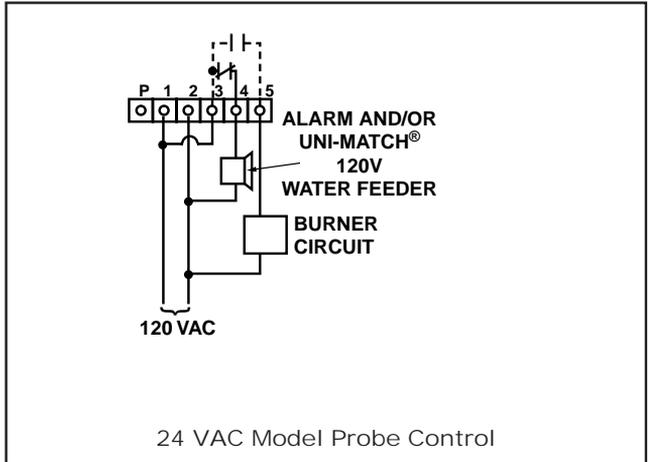
How to Wire Series PS-801 and PS-851 Low Water Cut-Offs

Electrical Installation

WARNING

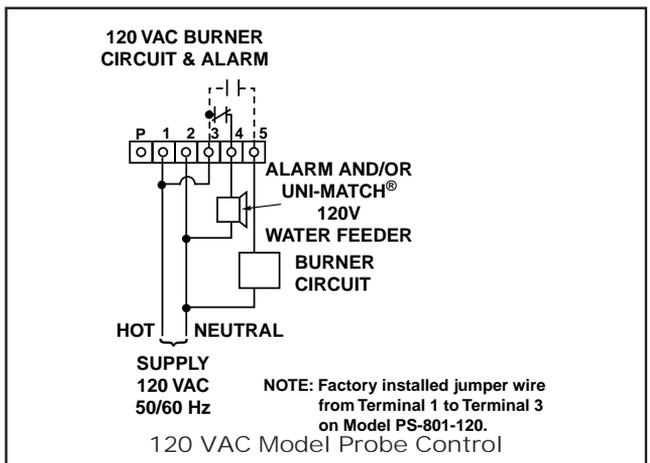
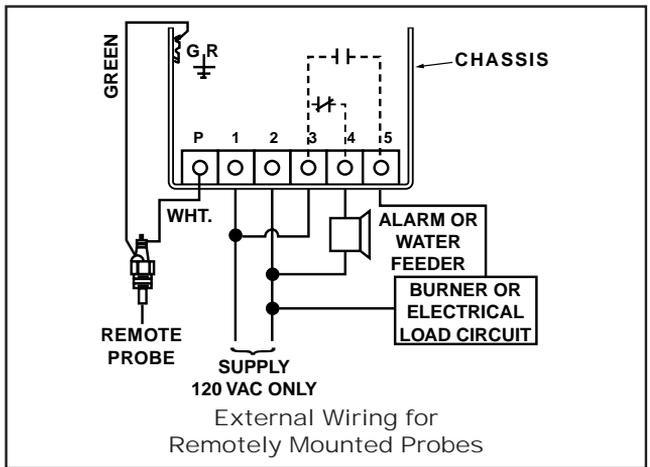
- If a jumper wire is used between terminals 1 and 3, the supply voltage to the low water cut-off must be the same as the burner circuit voltage.
- If a jumper wire is used between terminals 1 and 3, this low water cut-off must be installed in series and electrically ahead of all other limit and operating controls installed on the boiler, i.e., first in line relative to the burner circuit power source. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.

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



Electrical Ratings

Model	Voltage	Motor Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
24 VAC	24 VAC	—	—	50 VA at 24 VAC
120 VAC	120 VAC	7.5	43.2	125 VA
	240 VAC	3.75	21.6	120 or 240 VAC at 50 or 60 Hz



Series PS-801

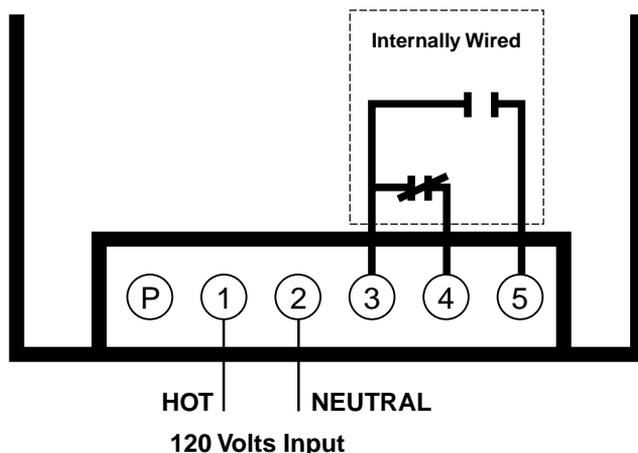
Electrical Installation Troubleshooting

This procedure deals with the new **DELAY ON MAKE** control (units manufactured after September 1994).

CAUTION	
	<p>To prevent electrical shock, do not touch or make contact with probe ends while the system is energized or activated.</p> <p>Failure to follow this caution could cause personal injury.</p>

1. Remove **all** wires from terminals **3**, **4** and **5**.
2. Put a continuity meter on terminals **3** & **5**.
3. Remove the probe lead – after 10 seconds the **red** lamp should light and there should be **no** continuity between terminals **3** & **5**.
4. Check to make sure that there **is** continuity between terminals **3** & **4**.
5. Short the probe lead to the chassis.
6. After **15** seconds the LED should go off and there should be continuity between terminals **3** & **5**, and no continuity between terminals **3** & **4**.

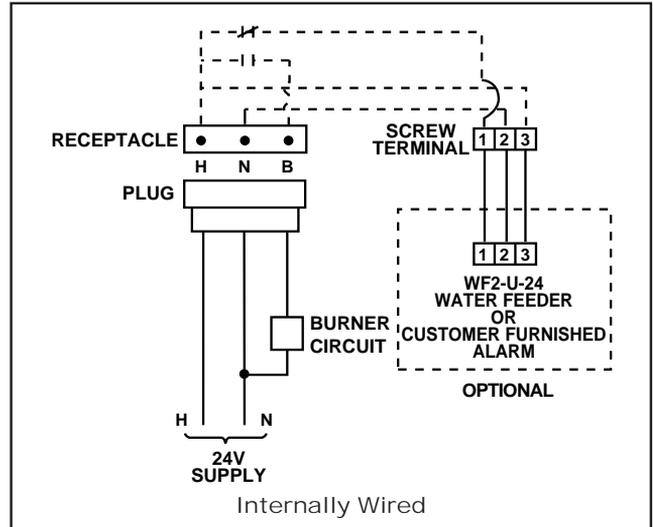
If the above tests work the problem is the external wiring or the probe.



How to Wire Series PS-802 and PS-852 (with 3-Position Terminal Strip) Low Water Cut-Offs

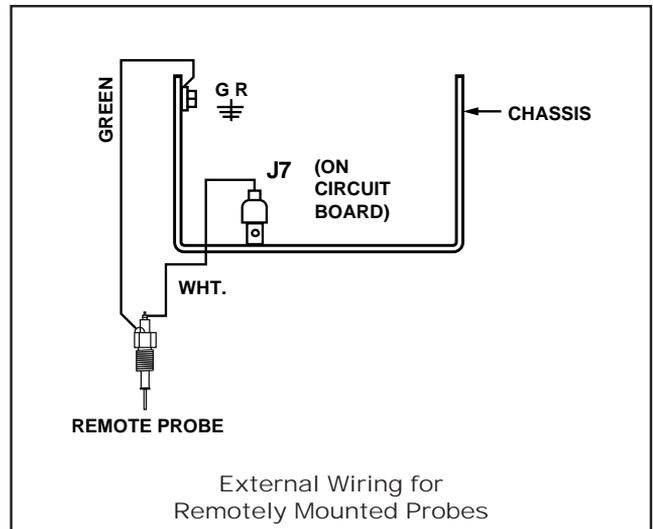
Electrical Installation

⚠ WARNING	
	<p>This low water cut-off must be installed in series and electrically ahead of all other limit and operating controls installed on the boiler, i.e., first in line relative to the burner circuit power source. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.</p> <p>Failure to follow this warning could cause an explosion and/or a fire, which could result in property damage, personal injury, or death.</p>
	



Electrical Ratings

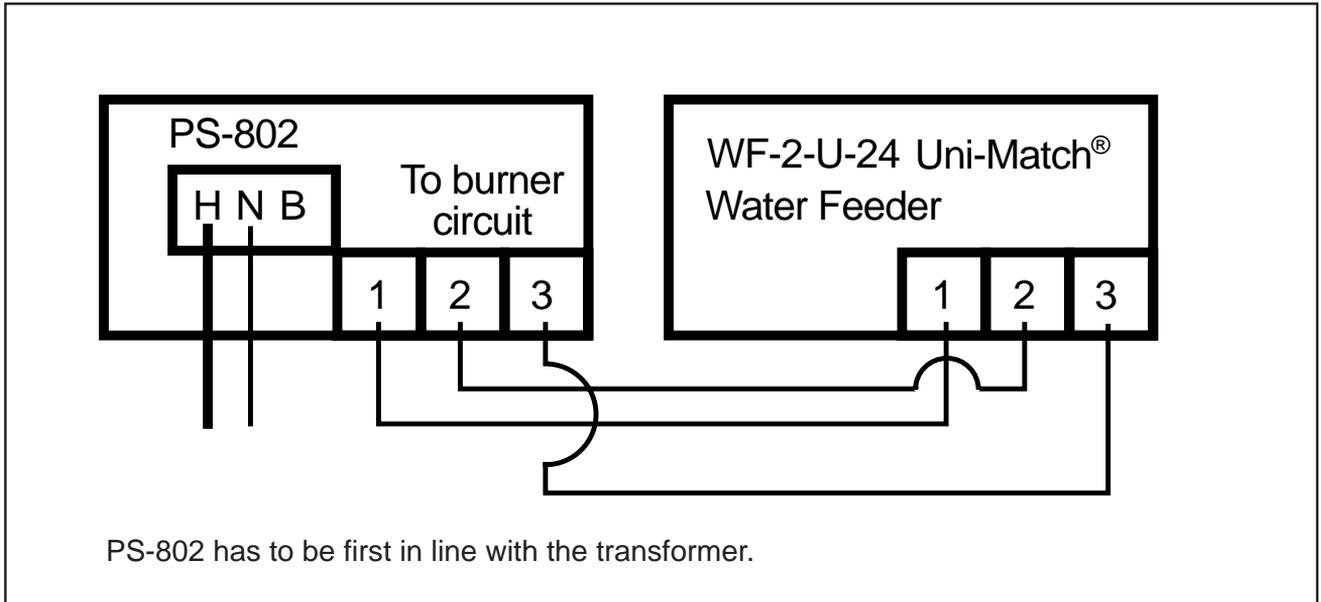
Model	Voltage	Motor Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
24 VAC	24 VAC	—	—	50 VA at 24 VAC
120 VAC	120 VAC	7.5	43.2	125 VA 120 or 240 VAC at 50 or 60 Hz
	240 VAC	3.75	21.6	



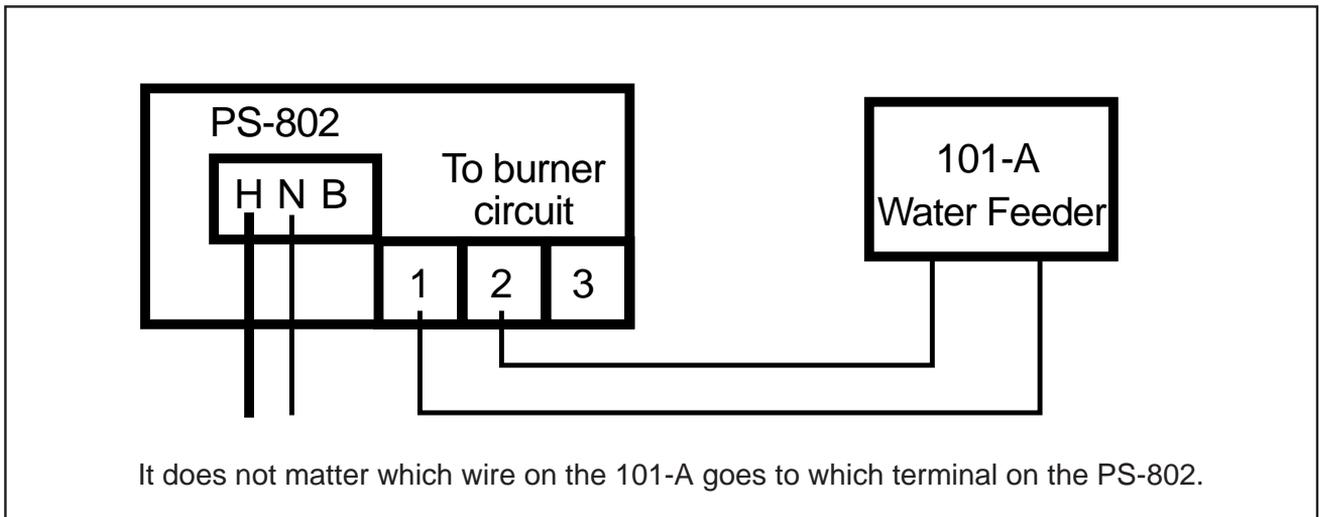
How to Wire Series PS-802 and PS-852 (with 3-Position Terminal Strip) Low Water Cut-Offs (Continued)

Electrical Installation

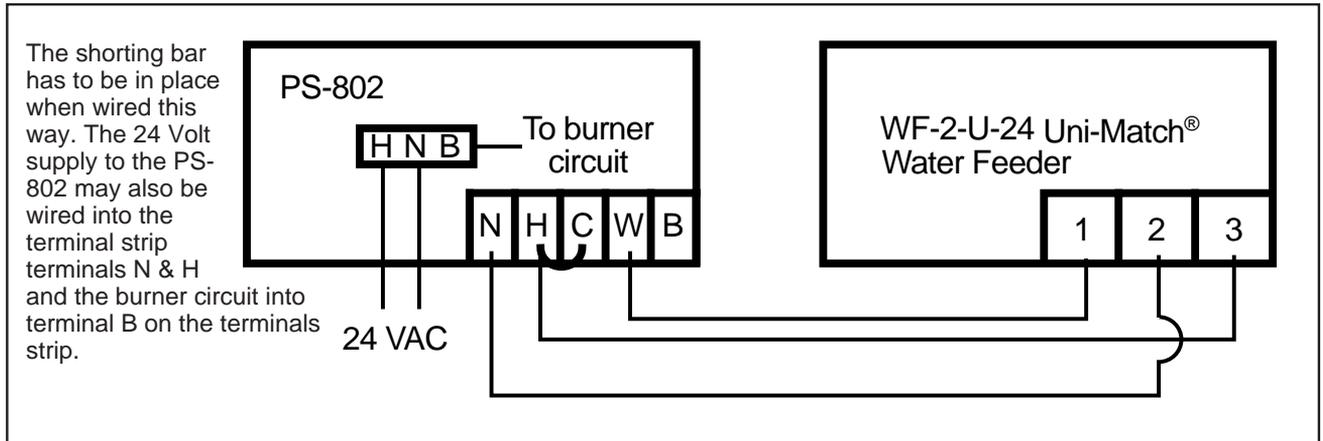
How to wire an original PS-802 & WF-2-U-24 Uni-Match® water feeder



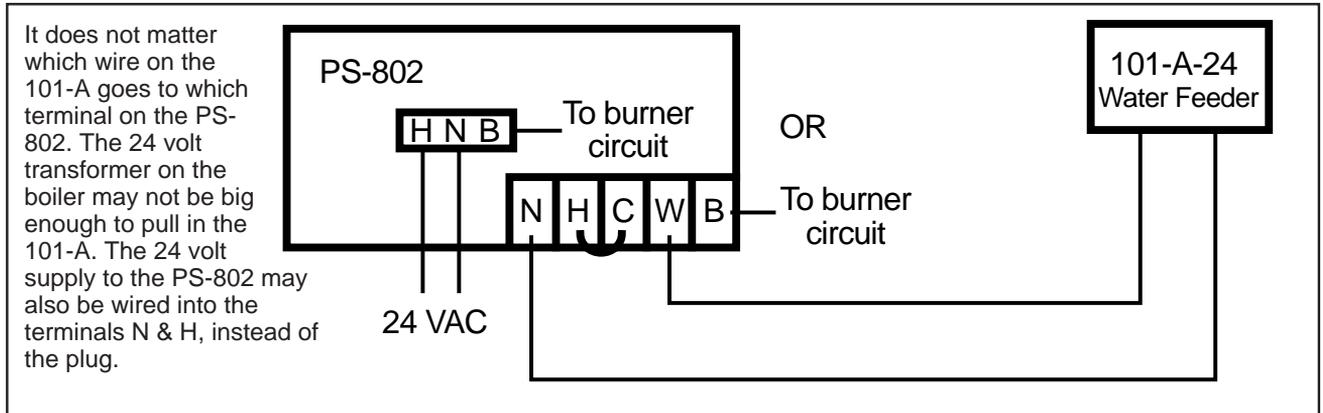
How to wire an original PS-802 & 101-A water feeder



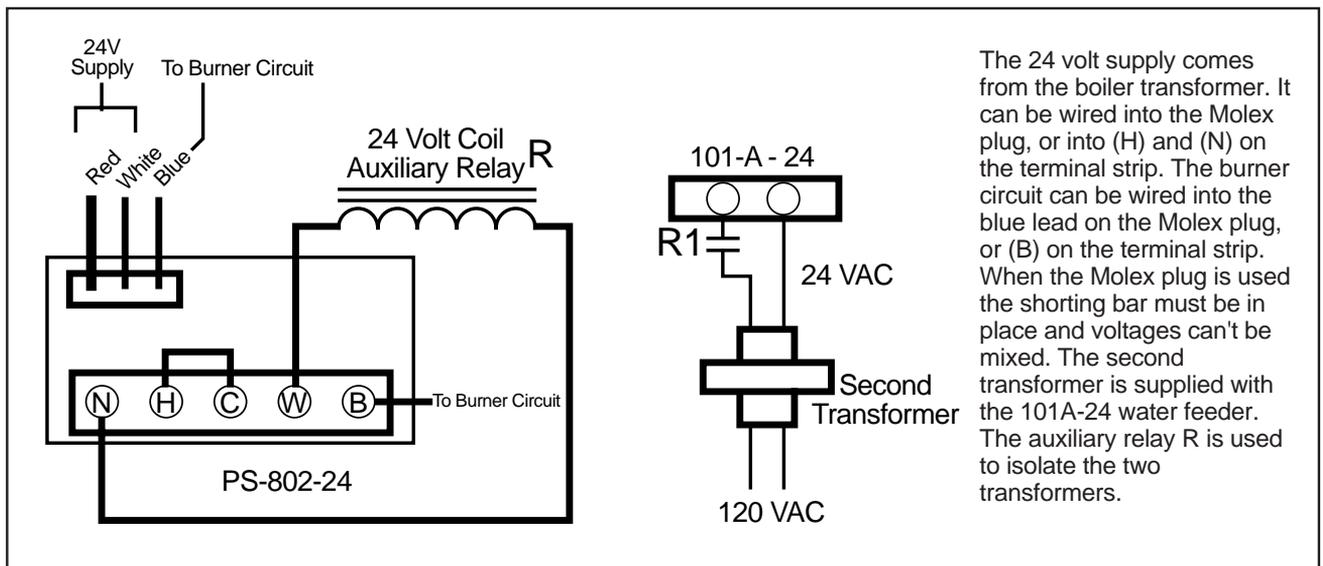
How to Wire Series PS-802 and PS-852 (with 5-Position Terminal Strip) Low Water Cut-Offs (Continued)



How to wire a current PS-802 & 101-A-24 water feeder



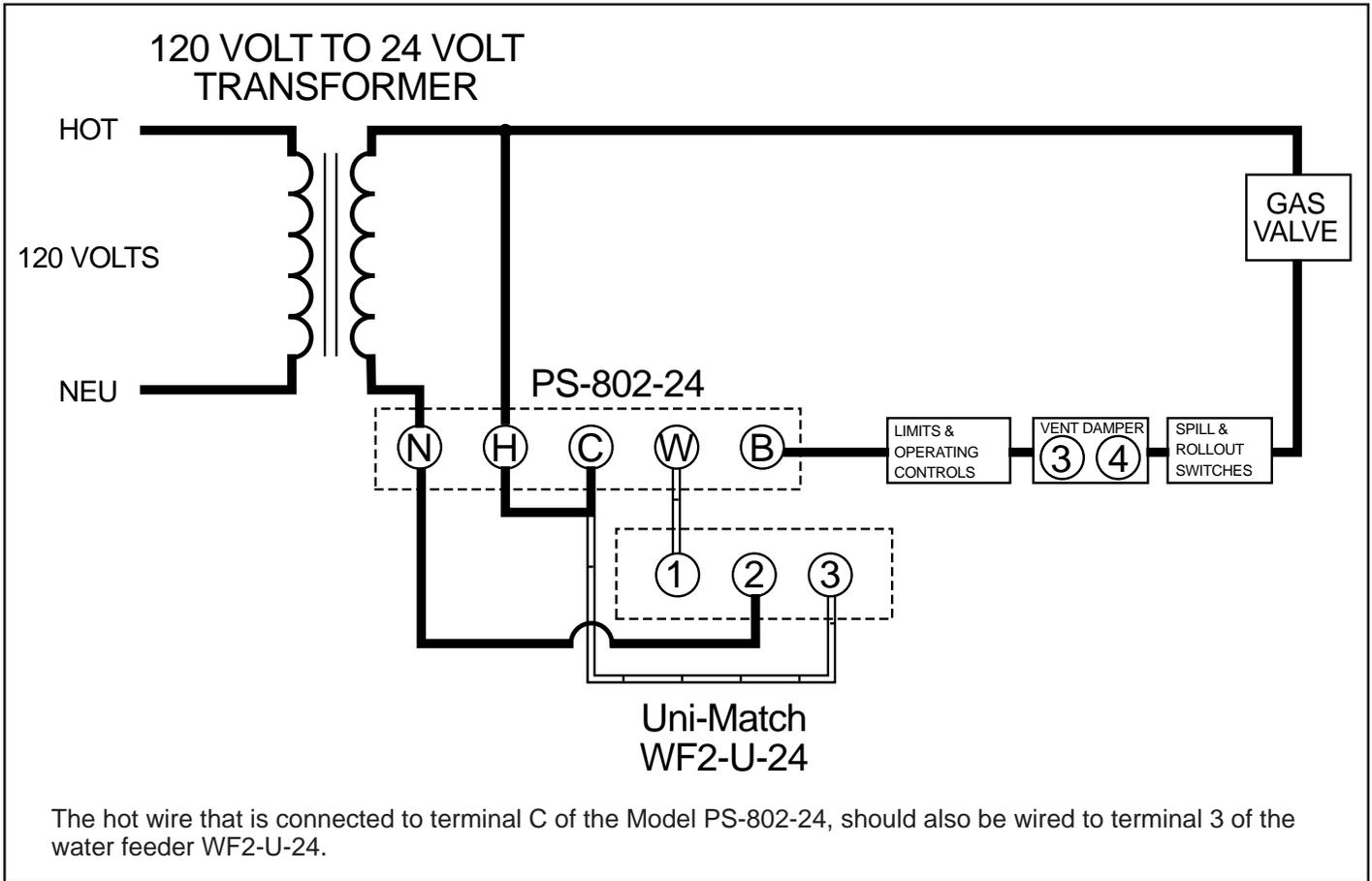
How to wire a PS-802-24 to a 101-A-24V using two transformers

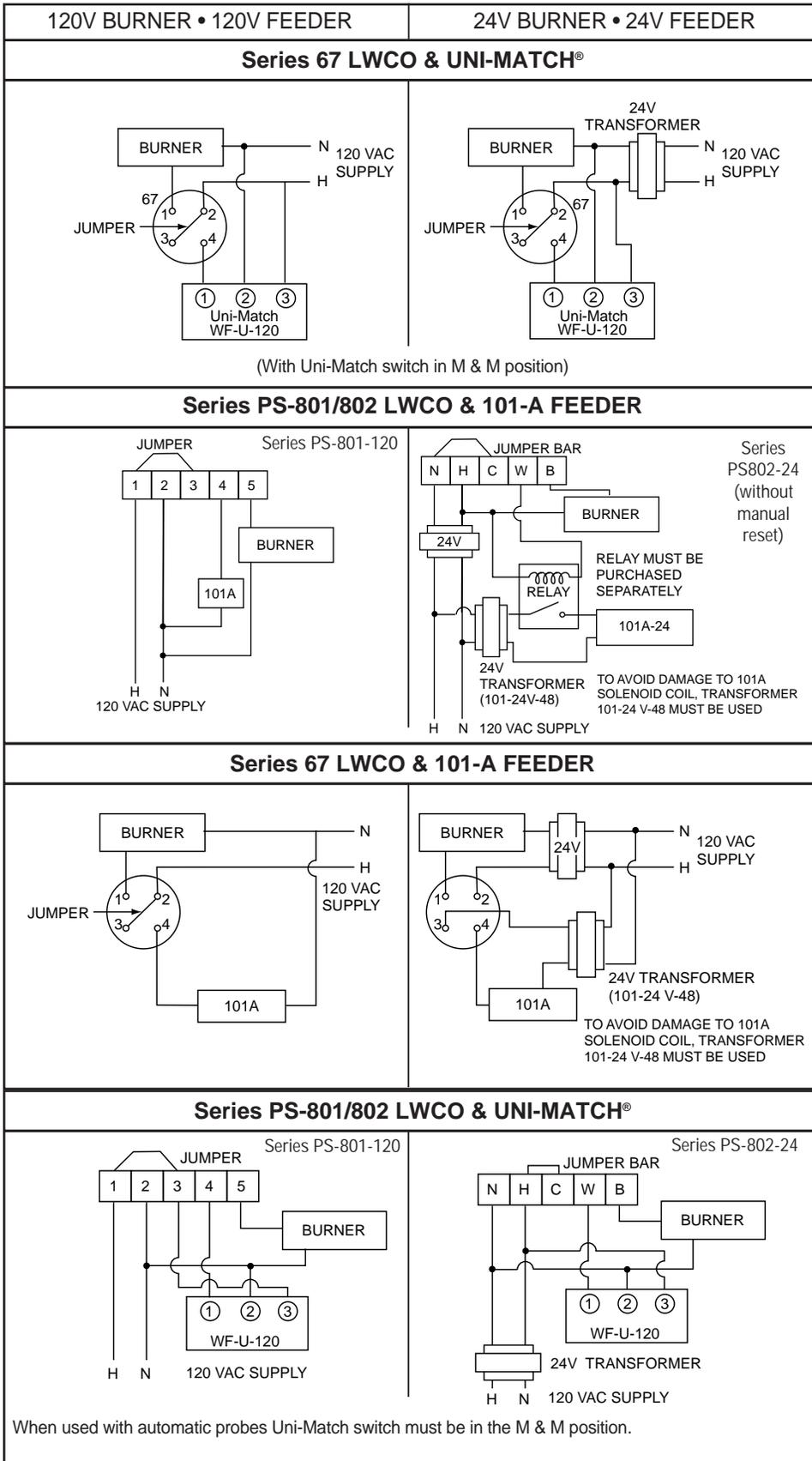


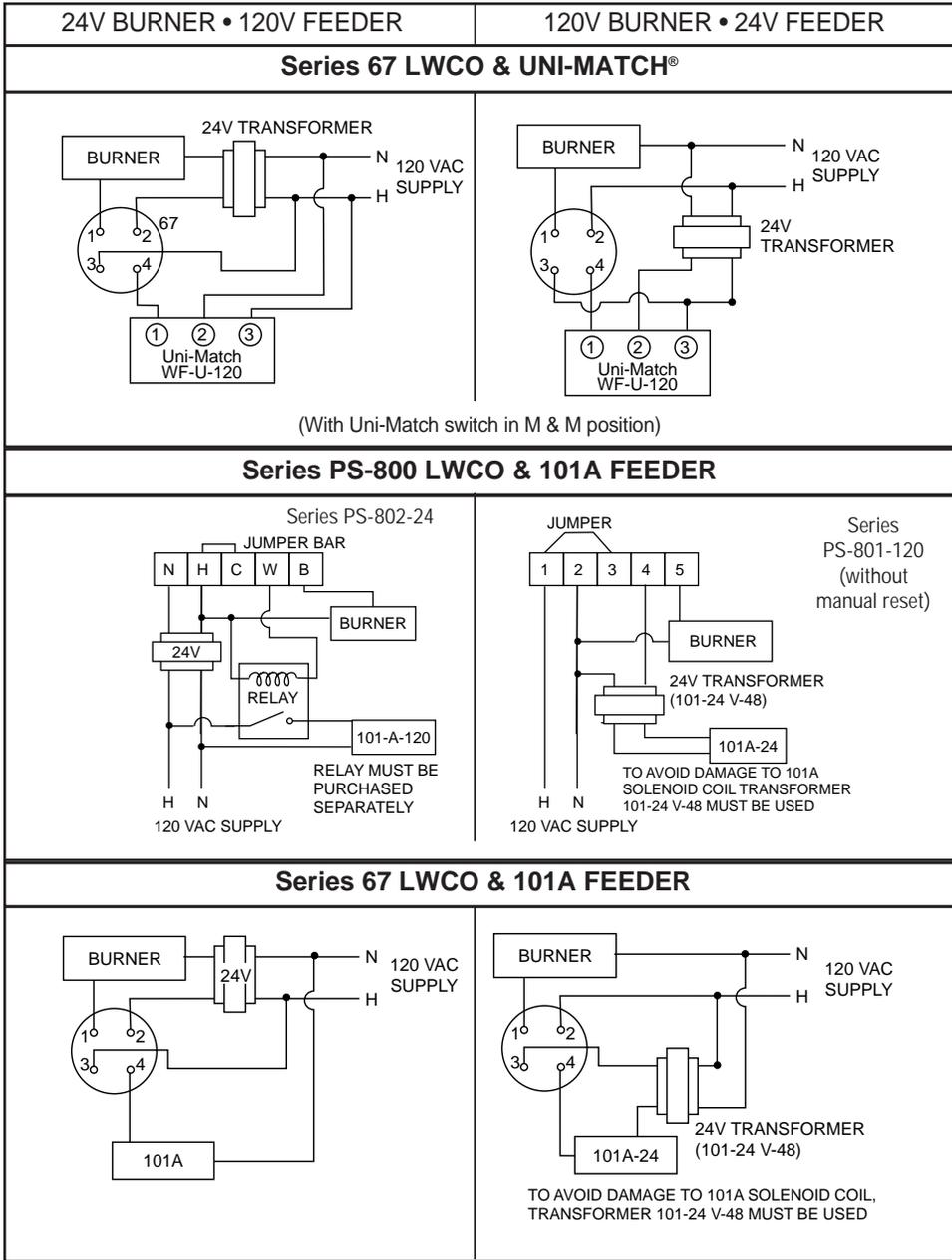
Model PS-802-24

How to wire a McDonnell & Miller Uni-Match® Electric Water Feeder with a Series PS 802-24 Low Water Cut-Off, when the boiler was wired by the manufacturer without a Water Feeder.

Electrical Installation



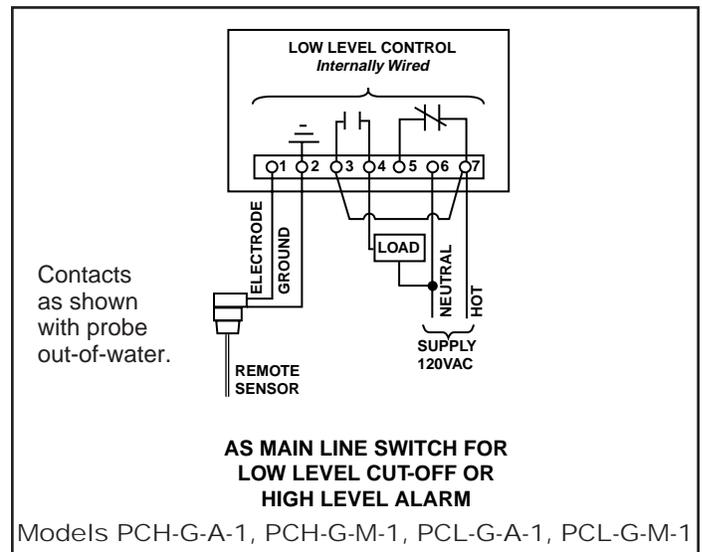
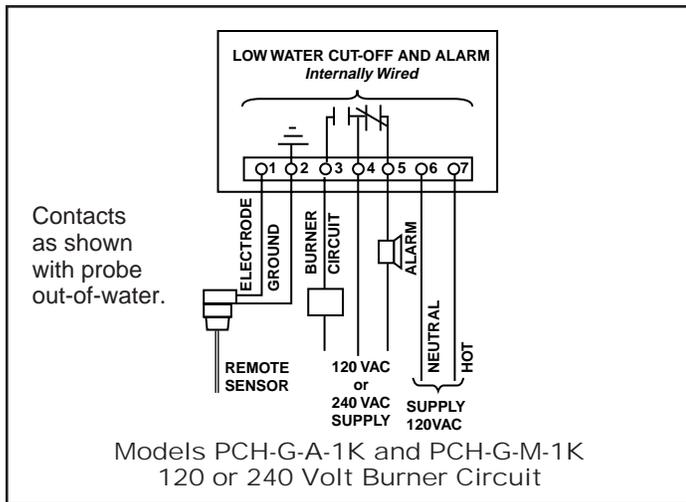
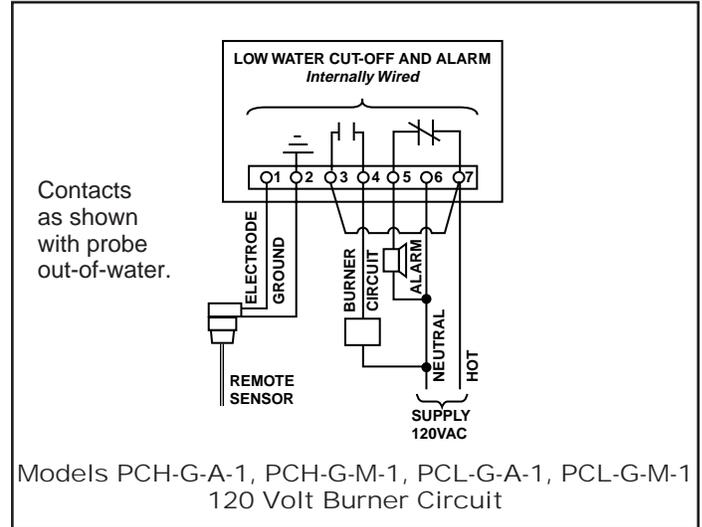
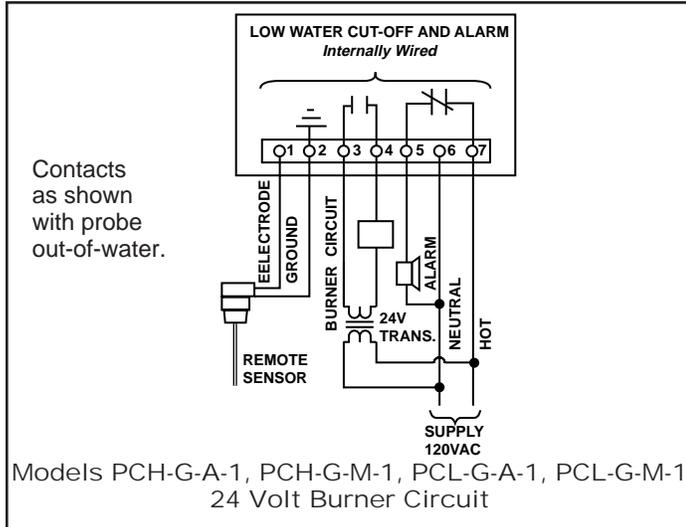




How to Wire Series PCH, PCL and LPC-2000 Liquid Level Controls

Electrical Installation

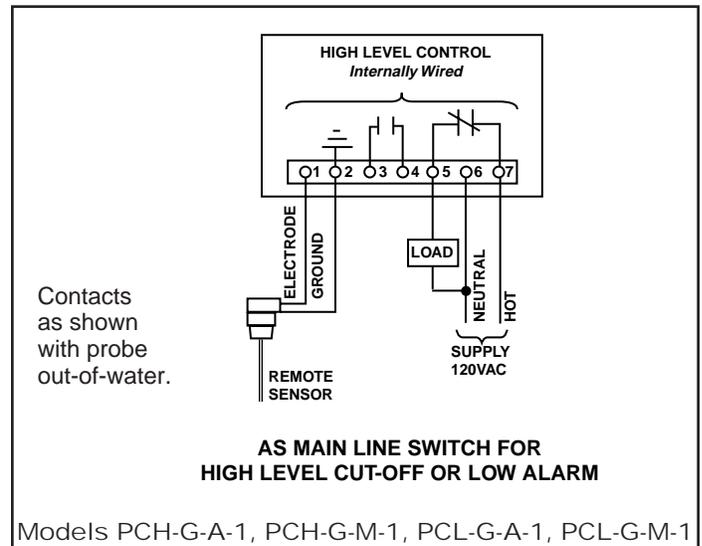
1 Level Control



WARNING

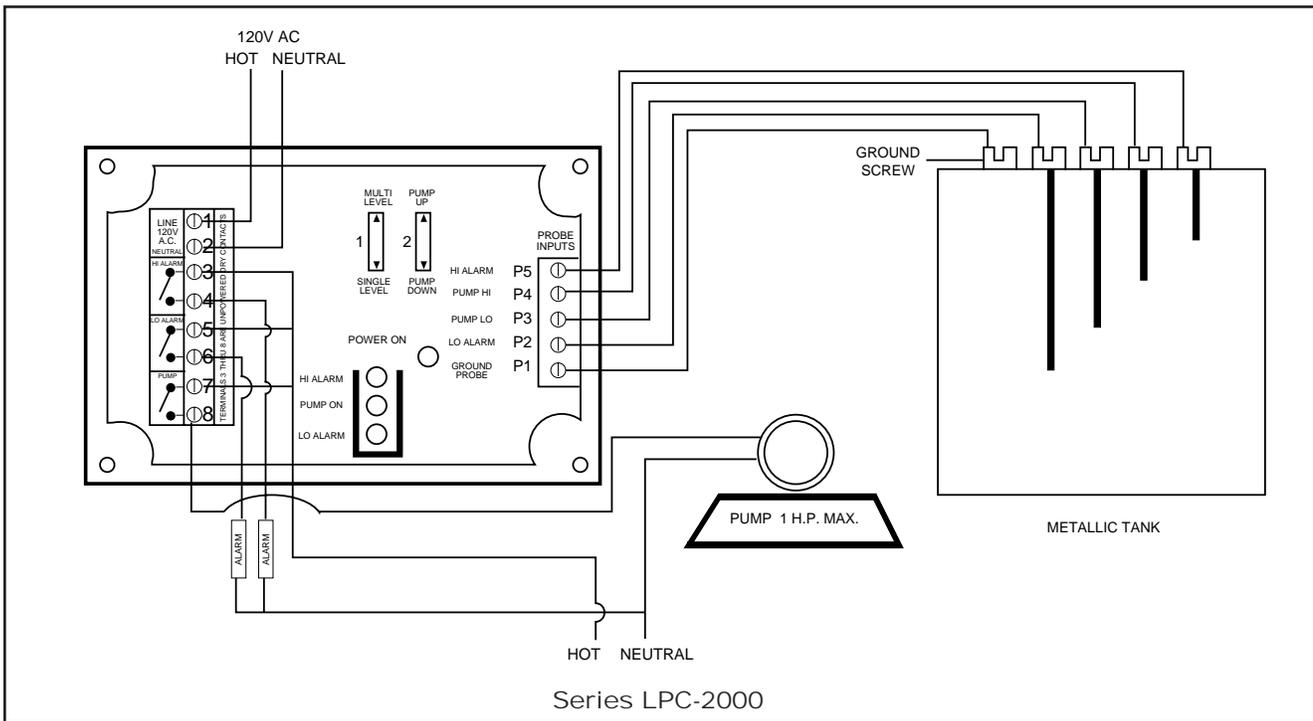
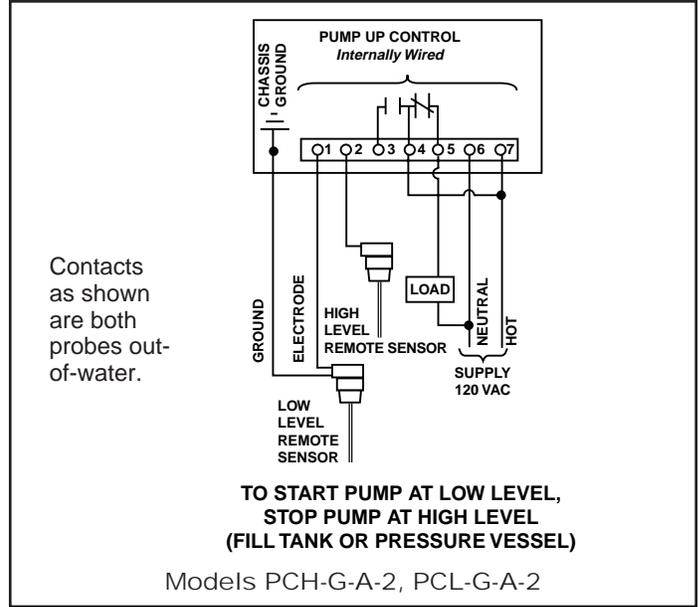
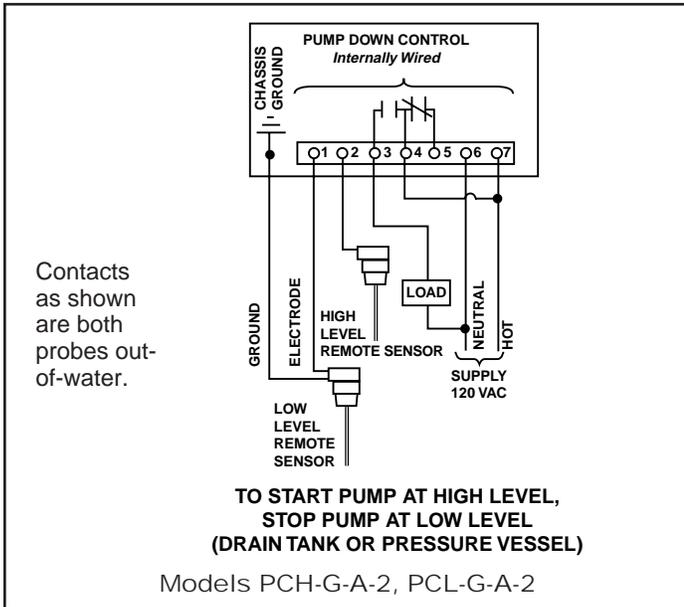
To prevent electrical shock, do not touch or make contact with probe ends while the system is energized or activated. This low water cut-off must be installed in series and electrically ahead of all other limit and operating controls installed on the boiler, i.e., first in line relative to the burner circuit power source. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.

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



How to Wire Series PCH, PCL and LPC-2000 Liquid Level Controls

2 Level Control



WARNING

To prevent a fire or flooding, a separate ground probe must be used for non-metallic tanks.

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

Conversion Factors

$$\text{Boiler Horsepower (BHP)} = \frac{\text{E.D.R.}}{139}$$

$$\text{Gallons of Water} = \frac{\text{Lbs. of Water}}{8.33}$$

$$\text{B.T.U.H.} = \text{E.D.R.} \times 240$$

$$\text{E.D.R.} = \frac{\text{B.T.U.H.}}{240}$$

$$\text{B.T.U.H.} = \text{B.H.P.} \times 33,479$$

Boiler Steaming Rate (Gallons Per Minute)

$$\text{GPM} = \frac{\text{E.D.R.}}{2000}$$

$$\text{GPM} = (\text{BHP}) \times 0.069$$

$$\text{GPM} = \frac{\text{B.T.U.}}{480,000}$$

$$\text{GPM} = \text{E.D.R.} \times 0.000496$$

$$\text{Pounds of condensate per hour} = \frac{\text{E.D.R.}}{4}$$

Formulas

Liquid Flow

$$\text{Velocity in Feet per Second (F.P.S.)} = \frac{\text{G.P.M.} \times 0.321}{\text{Pipe Area in Sq. In.}}$$

$$\text{Gallons per Minute (G.P.M.)} = \frac{\text{F.P.S.} \times \text{Pipe Area in Sq. In.}}{0.321}$$

Air Flow

$$\text{Cubic Feet Per Minute (C.F.M.)} = \text{Duct Area} \times \text{F.P.M.}$$

$$\text{F.P.M.} = \frac{\text{C.F.M.}}{\text{Duct Area}}$$

$$\text{One Square Foot} = (12" \times 12" = 144 \text{ sq. In.})$$

Always convert duct area into sq. ft.

Note: Usually velocity is in seconds for liquids, and minutes for air or gases.



Underwriters' Laboratories listed –
This product has been UL listed.



**Underwriters' Laboratories' of
Canada –**
This product has been UL listed.



Canadian Standards Association –
This product meets or exceeds the Canadian
Standards Association requirements.



Factory Mutual –

This product is approved for used in an
“accepted” system installation. Such
installations where the product falls in to
one of the following categories:

- Is used for the control or prevention of property damage.
- Those items that are improperly designed would pose serious hazards.

The definitions given in this section are only those that apply to heating and as referenced in this catalog. It is realized that some do not define the terms for all usages, but in the interest of clearance and space this sacrifice was made.

Absolute Pressure –

Actual pressure above zero, which is the atmospheric pressure added to the gauge pressure. It is expressed as a unit pressure such as lbs. per sq. in absolute.

Atmospheric Pressure –

The weight of a column of air, one square inch in cross section and extending from the earth to the upper level of the blanket of air surrounding the earth. This air exerts a pressure of 14.7 pounds per square inch at sea level, where water will boil at 212 degrees F. High altitudes have lower atmospheric pressure with correspondingly lower boiler point temperatures.

Blow Down Valve –

Also referred to as a blowoff valve. A valve which permits a boiler control to be flushed out, and the function of same to be checked.

Boiler –

A closed vessel in which steam is generated or in which water is heated by fire or electricity.

Boiler Crown –

The part of a boiler which forms the top of the furnace in a fire box boiler, or the equivalent surface in other types of boilers.

Boiler Feed Pump –

A pump that is governed by a control that monitors the actual boiler water level; and only adds water to the boiler when the boiler needs it. The pump controller is mounted on the boiler.

Boiler Heating Surface –

The area of the heat transmitting surfaces in contact with the water (or steam) in the boiler on one side and the fire or hot gases on the other.

Boiler Horse Power –

The equivalent evaporation of 34.5 lbs of water per hour at 212 degrees F to steam at 212 degrees F. This is equal to a heat output of 33,475 BTU per hour, which is equal to approximately 140 sq. ft. of steam radiation (EDR).

British Thermal Unit (BTU) –

The quantity of heat required to raise the temperature of 1 lb. of water 1 degree F. This is somewhat approximate but sufficiently accurate for any work discussed in this catalog.

BSPT –

British Standard Pipe Thread

Built-Ins –

A float-type control that screws directly into the boiler, such as the Series 69 and Series 70 low water cutoffs.

Condensate –

In steam heating, the water formed by cooling steam as in a radiator. The capacity of traps, pumps, etc., is sometimes expressed in lbs. of condensate they will handle per hour. One pound of condensate per hour is equal to approximately 4 sq. ft. of steam heating surface (240 BTU per hour per sq. ft.).

Condensate Pump –

A pump that is controlled by a switch mounted on the condensate tank. It adds water to the boiler when the condensate tank becomes full, whether the boiler needs water or not.

Dry Fire –

Insufficient water in a boiler to carry off the heat of combustion. It causes dry fire which results in cracked cast iron sections, and melted fire tubes.

Dry Saturated Steam –

Saturated steam containing no water in suspension.

EDR – (Equivalent Direct Radiation)

The amount of heating surface that will give off 240 BTU per hour when filled with a liquid that is heated to 215°F and surrounded by 70°F air. It may not have a direct relation to the actual surface area.

Fire Tube Boiler –

This type of boiler has the water on the external side of the tube and the heat (fire) on the internal side of the tube.

Flash (Steam) –

The rapid passing into steam of water at a high temperature when the pressure it is under is reduced so that its temperature is above that of its boiling point for the reduced pressure. For example: if hot condensate is discharged by a trap into a low pressure return or into the atmosphere, a certain percentage of the water will be immediately transformed into steam. It is also called re-evaporation.

Foaming –

A condition that occurs when an organic substance, usually oil, is floating on the surface of the water in a boiler. When the boiler is fired, a layer of foam develops on the surface of the water. This generally is indicated in the gauge glass by large swings in water level.

Freeze Up –

This refers to a structure that has lost its heating system, and the water in the piping freezes.

Furnace –

That part of a boiler or warm air heating plant in which combustion takes place. Sometimes also the complete heating unit of a warm air heating system.

Gauge Glass –

Sometimes called water glass or sight glass. It is a device that gives a visual means of the water level in a boiler. By code, all steam boilers are required to have one.

Head –

Unit pressure usually expressed ft. of water or mil-inches of water.

Heat –

That form of energy into which all other forms may be changed. Heat always flows from a body of higher temperature to a body of lower temperature. *See also: Latent Heat, Sensible Heat, Specific Heat, Total Heat, Heat of the Liquid.*

Heat of the Liquid –

The heat (BTU) contained in a liquid due to its temperature. The heat of the liquid for water is zero at 32 degrees F, and increases 1 BTU: approximately for every degree rise in temperature.

Heat Unit –

In the foot-pound-second system, the British Thermal Unit (BTU).

Heating Medium –

A substance such as water, steam, or air used to convey heat from the boiler, furnace, or other source of heat to the heating units from which the heat is dissipated.

Hot Water Heating System –

A heating system in which water is used as the medium by which heat is carried through pipes from the boiler to the heating units.

Latent Heat of Evaporation –

The heat (BTU of pound) necessary to change 1 pound of liquid into vapor without raising its temperature. In round numbers, this is equal to 960 BTU per pound of water.

Low Pressure Steam –

As defined by ASME, low pressure steam is 15 PSIG or less.

Make-Up Water –

Fresh water added to the system, by various means, to replace normal and abnormal water losses.

Manual Reset –

A control that has to have human input before the burner will come back on after a low water condition.

Maximum Differential (MD) –

A control with this designation has a greater spread between pump on and burner off.

Minimum Safe Water Level –

Also known as the minimum safe operating level. The minimum level of water in a boiler where the burner will

still operate. Below this level, the burner should be off due to low water.

NPT –

National Pipe Thread

Overfiring –

A situation where the burner does not turn off, for a number of reasons. The pressure of the system rises and the safety relief valve opens.

Pilot Valve –

A valve that uses a small valve to control a large valve.

Pressure –

Force per unit area such lb. per sq. inch.

Pressure Reducing Valve –

A piece of equipment for changing the pressure of a gas or liquid from a higher to a lower one.

Priming –

When the steam leaving the boiler carries large amounts of water with it, this is called priming. Insufficient heat, water hammer, and a flooded boiler, if the system has an automatic water feeder are some of the symptoms. It is generally caused by a high water level in the boiler, and near boiler piping.

Radiator –

A heating unit located within the room to be heated and exposed to view. A radiator transfers heat by radiation to objects "it can see" and by conduction to the surrounding air which in turn is circulated by natural convection.

Sensible Heat –

Heat which only increases the temperature of objects as opposed to latent heat.

Skimming –

A procedure for cleaning the surface of the water in a boiler. This procedure should be done on all new boiler installations, and when there is a foaming condition.

Steam –

Water in the vapor phase. The vapor formed when water has been heated to its boiling point, corresponding to the pressure it is under. *See also Dry Saturated Steam, Wet Saturated Steam, Super Heated Steam.*

Steam Heating System –

A heating system in which the heating units give up their heat to the room by condensing the steam furnished to them by a boiler or other source.

Steam Pop Safety Valve (Relief Valve) –

A device to prevent over pressure in a boiler. It should be set for 15 psi on low pressure steam boilers. On high pressure boilers, it should be set at the maximum

working pressure of the boiler, or lower if the boiler is not going to be operated at its maximum pressure.

Steam Trap –

A device for allowing the passage of condensate and air but preventing the passage of steam.

Supply Mains –

The pipes through which the heating medium flows from the boiler or source of supply to the run-outs and riser leading to the heating units.

Two-Pipe System (Steam or Water) –

A heating system in which one pipe is used for the supply main and another for the return main. The essential feature of a two-pipe hot water system is that each heating unit receives a direct supply of the heating medium which cannot have served a preceding heating unit.

Tube Bundle –

A single tube (pipe) formed into a tight array so as to present a large surface area in a small space.

Vacuum Heating System (Steam) –

A one or two-pipe heating system equipped with the necessary accessory apparatus to permit the pressure in the system to go below atmospheric.

Vapor –

Any substance in the gaseous state.

Vapor Heating System (Steam) –

A two-pipe heating system which operates under pressure at or near atmospheric and which returns the condensation to the boiler or receiver by gravity.

Vent Valve (Steam) –

A device for permitting air to be forced out of a heating unit or pipe and which closes against water and steam.

Vent Valve (Water) –

A device permitting air to be pushed out of a pipe or heating unit but which closes against water.

Water Tube Boilers –

This type of boiler has the water circulated through a tube bundle with the heat applied on the external side of the tube.

Wet Return (Steam) –

That part of a return main of a steam heating system which is completely filled with water of condensation.

Warranty Policy

ITT McDonnell & Miller warrants for a period of two (2) years from the date of manufacture or one (1) year from date of installation, whichever comes first, that all ITT McDonnell & Miller and all Hoffman Specialty products furnished by it are free from defects in materials and workmanship.

ITT McDonnell & Miller's liability for any breach of this Warranty shall be limited solely to replacement or repair at the sole option of ITT McDonnell & Miller, of any part or parts found to be defective during the Warranty Period providing the Product is properly installed and is being used for its intended purpose. Buyer must notify ITT McDonnell & Miller of any breach of this warranty, within the aforementioned Warranty Period by notifying the ITT McDonnell & Miller representative with responsibility for servicing the Buyer's account. Further, product alleged to be defective must be shipped by buyer to ITT McDonnell & Miller's representative, transportation charges prepaid.

It is expressly agreed that this shall be the sole and exclusive remedy of the buyer, under no circumstances shall ITT McDonnell & Miller be liable for any costs, loss, expense, damages, special damages, incidental damages or consequential damages arising directly or indirectly from the design, manufacture, sale, or use or repair of the product whether based upon warranty, contract, negligence or strict liability. In no event will liability exceed the purchase price of the product.

The warranty and limits of liability contained herein are in lieu of all other warranties and liabilities expressed or implied. All implied warranties or merchantability and fitness for a particular purpose are hereby disclaimed by ITT McDonnell & Miller and excluded from the warranty.

ITT McDonnell & Miller neither assumes nor authorizes any person to assume for it, any other Warranty obligation in connection with the sale of the Product. This Warranty shall not apply to any product or parts of products which (a) have been repaired or altered outside of authorized ITT McDonnell & Miller facilities; (b) have been subject to misuse, negligence or accident; or (c) have been used in a manner contrary to ITT McDonnell & Miller instructions.

In the case of Products not manufactured by ITT McDonnell & Miller, there is no warranty from ITT McDonnell & Miller, but ITT McDonnell & Miller will extend to the buyer any Warranty from ITT McDonnell & Miller's supplier of such products

Warranty Procedure

Return product to place of purchase or contact our local Manufacturer's Representative.

Return Goods Policy

Unused material may be returned for credit only with the written or oral consent of ITT McDonnell & Miller. This consent is in the form of an RGA number issued by ITT McDonnell & Miller, and is subject to the following conditions.

1. Materials must be unused, of current design, and in original cartons.
2. Credit will be issued based upon either a referenced invoice or product date code if an invoice is not referenced. Requester is to supply copy of the referenced invoice if requested.
3. A 25% restocking charge will apply.
4. Unauthorized material returned to ITT McDonnell & Miller will be either refused or sent back to the sender freight collect by a carrier chosen by ITT McDonnell & Miller.
5. If material is received but subsequently found not to have met the above conditions, it will be sent back to the sender freight collect by a carrier chosen by ITT McDonnell & Miller.
6. Products which are obsolete or made to special order are not returnable.

IMPORTANT

- Previously used controls should never be installed on a new system. Always install new controls on a new boiler or system.
- A more frequent replacement interval may be necessary based on the condition of the unit at time of inspection. ITT McDonnell & Miller's warranty is one (1) year from date of installation or two (2) years from the date of manufacture.
- Use of water treatment can diminish product life. In such cases, components should be replaced on a more frequent basis.
- Visually inspect the inside of the float chamber during the annual inspection. Partial disassembly may be required.

Inspect all controls annually, and replace, repair or clean, as needed. All chambered units are to be blown down per manufacturers instructions and local code requirements. These requirements are to be determined by the local service company, and are based on water quality and system operation variables.

Refer to the installation instructions provided with the product for specific assembly and test procedures.

McDonnell & Miller products must also be maintained in accordance with the following ASME Code.

ASME Boiler and Pressure Vessel Code – Section VI Paragraph 7.07 G

Low-Water Fuel Cut-Off and Water Feeder Maintenance. Low-water fuel cut-offs and water feeders should be dismantled annually, by qualified personnel, to the extent necessary to insure freedom from obstructions and proper functioning of the working parts., Inspect connecting lines to boiler for accumulation of mud, scale, etc., and clean as required. Examine all visible wiring for brittle or worn insulation and make sure electrical contacts are clean and that they function properly. Give

special attention to solder joints on bellows and float when this type of control is used. Check float for evidence of collapse and check mercury bulb (where applicable) for mercury separation or discoloration. Do not attempt to repair mechanisms in the field. Complete replacement mechanisms, including necessary gaskets and installation instructions are available from the manufacturer. After reassembly, test as per 7.05H.

ITT McDonnell & Miller controls manufactured after 1972 feature a stamped date code, so you can easily check the life expectancy and recommended replacement intervals. **If a control has no date stamp or does not have the ITT logo on it – replace it!**

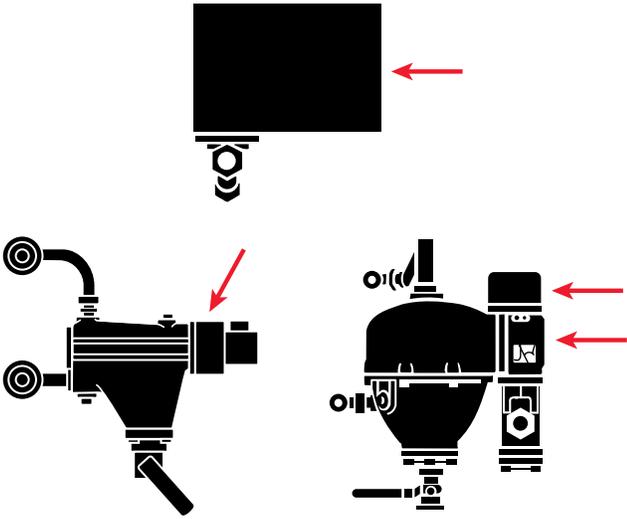
See the chart (right) for more specific information on maintenance and replacement intervals. Below are guides to help you quickly locate and translate the date code on McDonnell & Miller controls.

WHERE TO FIND



McDonnell & Miller

DATE CODES





McDonnell & Miller

Product Date Code Translation

Month	Year	Example
A = January	W = 1979	<p>K09 Translates to October 1990</p>
B = February	X = 1980	
C = March	Y = 1981	
D = April	Z = 1982	
E = May	38 = 1983	
F = June	48 = 1984	
G = July	58 = 1985	
H = August	68 = 1986	
J = September	78 = 1987	
K = October	88 = 1988	
L = November	98 = 1989	<p>Beginning 1996 the year is no longer reversed. 96K Translates to October 1996</p>
M = December	09 = 1990	
	19 = 1991	
	29 = 1992	
	39 = 1993	
	49 = 1994	
	59 = 1995	
	96 = 1996	
	97 = 1997	
	98 = 1998	
	99 = 1999	
	00 = 2000	

Recommended Replacement Intervals

Product	Series	Recommended Maintenance	Recommended Replacement Interval (Maximum)
Low Water Cut-Offs	150, 157, 158, 159, 150S, 157S, 158S, 159S	Blow down and test daily inspect annually.	15 years
	69, 169, 269, 369, 469	Inspect and test annually.	10 years
	67, 767 70, 70-B	Blow down weekly. Inspect and test annually.	10 years
	61, 63, 64, 764	Blow down weekly. Inspect and test annually.	10 years
	42	Blow down daily. Inspect and test annually.	10 years
	93, 94, 193, 194	Blow down and test daily. Inspect and test annually.	15 years
	750, PS-800, PA-850, 900, RB-120	Inspect and test annually.	15 years
	RB-24	Inspect and test annually.	10 years
Water Feeders	WF2/Uni-Match®	Inspect and test annually. Replace filter annually.	10 years
	101-A	Inspect, test, and replace cartridge valve annually.	10 years
	21, 221, 25-A, 53, 551-S, 847, 3155	Inspect and test annually.	15 years
	47, 51, 53, 247	Blow down weekly. Inspect and replace cartridge valve annually.	10 years
Liquid Level Controls	LPC-2000, PS-850, PCH PCL, PFC, VFC, VFS	Inspect and test annually.	15 years
	18, 18-SS, 27-W	Inspect and test annually.	5 years
Replacement Blow Down Valves	14-B	Inspect and test annually.	10 years
	14	Replace with 14-B blow down valve.	3 years
Replacement Probes	750, PS-800, PS-850, 900, RB-120, PCH, PCL	Inspect annually.	10 years
Replacement Head Mechanisms for Commercial/Industrial Applications	25-A, 42, 51, 51-S, 53, 61, 63, 64, 67, 70, 93 94, 150, 150S, 157, 157S, 193, 194	Inspect and test annually.	5 years

FOR MORE DETAILS CALL YOUR LOCAL ITT McDONNELL & MILLER REPRESENTATIVE

ALABAMA

Mangham & Associates, Inc.
Birmingham—205/956-2362
Fax: 205/956-2477

ALASKA

Larry Harrington Co., Inc.
Bellevue (Seattle) WA—425/455-0800
Fax: 425/455-4640

ARIZONA

J & B Sales Company
Phoenix—602/258-1545, Fax: 602/258-9719

ARKANSAS

Johnson & Scott, Inc.
Little Rock—501/370-5050
Fax: 501/370-5051

Hydronic Technology, Inc.

Shreveport, LA—318/797-1500
Fax: 318/797-1509

Boone & Boone Sales Co., Inc.

Tulsa, OK—918/664-9756, Fax: 918/664-1675

CALIFORNIA

California Hydronics Corp.
Hayward (San Francisco)—510/293-1993
Fax: 510/293-3080

Roseville (Sacramento)—916/773-1908

Fax: 916/773-1910

Dawson Company

Altadena (Los Angeles)—626/797-9710
Fax: 626/798-4659

San Diego—619/541-7867, Fax: 619/541-0333

COLORADO

McNevin Company
Denver—303/322-0165, Fax: 303/322-0374

CONNECTICUT

The Bernard M. Packtor Company
Hamden (New Haven) 203/288-5241
Fax: 203-287-1798

DELAWARE

R. D. Bitzer Co., Inc.
Philadelphia, PA—215/635-2818
Fax: 215/635-0615

Cummins-Wagner Co., Inc.

Annapolis Junction, MD—800/966-1277
Fax: 301/490-7156

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George A. Israel Jr., Inc.
Jacksonville—904/355-7867
Fax: 904/355-0077

Miami—305/592-5343, Fax: 305/591-4356

Orlando—407/423-5078, Fax: 407/423-0918

Tallahassee—904/656-2055

Fax: 904/656-1475

Tampa—813/839-2161, Fax: 813/832-3182

Mangham & Associates, Inc.

Birmingham, AL—205/956-2362

Fax: 205/956-2477

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Fax: 904/355-0077

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Fax: 904/656-1475

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Altadena (Los Angeles), CA—626/797-9710
Fax: 626/798-4659

IDAHO

Gritton & Associates, Inc.
Salt Lake City, UT—801/486-0767
Fax: 801/485-6364

Larry Harrington Company, Inc.

Portland, OR—503/228-4324

Fax: 503/228-0219

ILLINOIS

Bornquist, Inc.
Chicago—773/774-2800, Fax: 773/763-6534

Blackmore & Glunt, Inc.

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314/878-4313, Fax: 314/878-6029

John A. Sandberg Co., Inc.

East Moline—309/796-2371

Fax: 309/796-2330

Hydronic & Steam Equipment Co., Inc.

Indianapolis, IN—800/669-4926

Fax: 317/577-7109

INDIANA

Hydronic & Steam Equipment Co., Inc.

Evansville—800/473-2753, Fax: 812/479-7650

Fl. Wayne—219/489-5785, Fax: 219/489-4369

Indianapolis—800/669-4926

Fax: 317/577-7109

South Bend—800/932-6490

Fax: 219/234-6611

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Griffith—773/774-2800, Fax: 773/763-6534

Blackmore & Glunt, Inc.

Cincinnati, OH—513/489-5225

Fax: 513/489-8755

IOWA

Products, Inc.

Des Moines—515/288-5738

Fax: 515/288-2574

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East Moline, IL—309/796-2371

Fax: 309/796-2330

Verne Simmonds Company

Omaha, NE—402/592-3131

Fax: 402/592-0853

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Fax: 913/469-1085

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Fax: 513/489-8755

Hydronic & Steam Equipment Co., Inc.

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Fax: 812/479-7650

Johnson & Scott

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Fax: 615/242-9243

LOUISIANA

Hydronic Technology, Inc.

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Fax: 504/827-1167

Shreveport—318/797-1500

Fax: 318/797-1509

MAINE

F.I.A., Inc.

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Fax: 617/933-3965

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Fax: 301/490-7156

ThermoFlo Equipment Co., Inc.

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Fax: 412/367-0842

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Fax: 518/458-8776

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Fax: 248/354-3763

Grand Rapids—616/957-0630

Fax: 616/957-5190

Saginaw—517/777-2960, Fax: 517/777-5061

Hydro-Flo Products, Inc.

Brookfield (Milwaukee) WI—

414/781-2810, Fax: 414/781-2228

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Bloomington—612/854-3621

Fax: 612/854-7586

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New Orleans, LA—504/827-1163

Fax: 504/827-1167

Johnson & Scott

Little Rock, AR—501/370-5050

Fax: 501/370-5051

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Fax: 913/469-1085

Maryland Heights (St. Louis)—

314/878-4313, Fax: 314/878-6029

Johnson & Scott

Memphis, TN—901/755-2201

Fax: 901/755-2977

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Fax: 509/325-6838

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Verne Simmonds Company

Omaha—402/592-3131, Fax: 402/592-0853

NEVADA

California Hydronics Corp.

Sacramento, CA—916/773-1908

Fax: 916/773-1910

Dawson Company

Las Vegas, NV—702/735-1226

Fax: 702/735-1232

Gritton & Associates, Inc.

Salt Lake City, UT—801/486-0767

Fax: 801/485-6364

NEW HAMPSHIRE

F.I.A., Inc.

Woburn (Boston) MA—617/938-8900

Fax: 617/933-3965

NEW JERSEY

Wallace-Eannace Assoc., Inc.

Franklin Lakes—201/891-9550

Fax: 201/891-4298

R. D. Bitzer Co., Inc.

Philadelphia, PA—215/635-2818

Fax: 215/635-0615

NEW MEXICO

Boyd Engineering Company, Inc.

Albuquerque—505/275-1250

Fax: 505/275-1193

NEW YORK

Wallace-Eannace Assoc., Inc.

Plainview—516/454-9300, Fax: 516/454-9307

Frank P. Langley Company, Inc.

Johnson City—607/766-9950,

Fax: 607/766-9948

Rochester—716/248-5010, Fax: 716/381-0512

Amherst (Buffalo)—716/691-7575

Fax: 716/691-7347

The Bernard M. Packtor Company

Albany—518/459-1060, Fax: 518/458-8776

Syracuse Thermal Products, Inc.

East Syracuse—315/437-7321

Fax: 315/437-7429

NORTH CAROLINA

James M. Pleasants Company, Inc.

Greensboro—800/365-9010

Fax: 336/378-2588

NORTH DAKOTA

Bernard J. Mulcahy Co., Inc.

Bloomington, MN—612/854-3621

Fax: 612/854-7586

OHIO

Blackmore & Glunt, Inc.

Cincinnati—513/489-5225, Fax: 513/489-8755

Omni-Flow, Inc.

Macedonia (Cleveland)—330/468-1102

Fax: 330/468-1113

Steffens-Shultz, Inc.

Columbus—614/274-5515, Fax: 614/274-0126

Dayton—937/278-7903, Fax: 937/278-7825

ThermoFlo Equipment Co., Inc.

Pittsburgh, PA—412/366-2012

Fax: 412/367-0842

OKLAHOMA

Boone & Boone Sales Co., Inc.

Oklahoma City—405/525-7475

Fax: 405/521-1448

Tulsa—918/664-9756, Fax: 918/664-1675

OREGON

Larry Harrington Company, Inc.

Portland—503/228-4324, Fax: 503/228-0219

PENNSYLVANIA

R. D. Bitzer Co., Inc.

Philadelphia—215/635-2818

Fax: 215/635-0615

ThermoFlo Equipment Co., Inc.

Pittsburgh—412/366-2012, Fax: 412/367-0842

Frank P. Langley Co., Inc.

Amherst (Buffalo) NY—716/691-7575

Fax: 716/691-7347

RHODE ISLAND

F.I.A., Inc.

Woburn (Boston) MA—617/938-8900

Fax: 617/933-3965

SOUTH CAROLINA

James M. Pleasants Co., Inc.

Greensboro, NC—800/365-9010

Fax: 336/378-2588

SOUTH DAKOTA

Bernard J. Mulcahy Co., Inc.

Bloomington, MN—612/854-3621

Fax: 612/854-7586

Verne Simmonds Co.

Omaha, NE—402/592-3131

Fax: 402/592-0853

TENNESSEE

Johnson & Scott

Nashville—615/254-5454, Fax: 615/242-9243

Memphis—901/755-2201, Fax: 901/755-2977

Clary & Associates, Inc.

Atlanta, GA—404/873-1861

Fax: 404/873-1867