Fall 2021 Newsletter

Modulating Feedwater Valves: The Method Behind the Movement

By Brian Grinestaff

The WARE Mod-V modulating feedwater valve was developed to answer an industry need for greater control, efficiency, and performance in larger boiler systems. It's a smart solution that's showing up in more and more of them, and for good reason. With properly modulated feedwater, a boiler can operate with better efficiency, and be able to respond to shifts in demand without appreciable lag. That can be a game-changer.

To keep a boiler system operating at optimal efficiency, it needs enough water to do its job. However, the definition of "enough" changes throughout the day as demand for steam increases and decreases. This is called "load swing", and different boiler systems use different methods to compensate for it. More and more, the flow of supply water is being controlled through the use of modulating feed valves, and there are a lot of reasons why.

Since smaller boiler systems typically don't have to adjust to large load swings, they often rely on simple float-based systems to keep the water coming. In these "on/off" setups, when the water gets low, a float switch activates a pump or series of pumps. Once the demand level is satisfied, the float rises, the switch closes, the pumps shut off, and the boiler continues with business as usual. It's not terribly complex, but it gets the job done.

Larger boiler systems typically experience much larger load swings than smaller systems. Consequently, they require greater and more frequent adjustments to the volume of supply water. Because the water demand can be so great, most larger boilers typically require a continuous supply of feedwater to prevent a dangerous low-water situation from developing during peak use.

The all-on/all-off nature of a float switch means it really isn't an option for continuous supply. Furthermore, float switches can't really respond to demand in real time. If the water level gets too low, there's going to be a lapse in supply as the float switch and pumps get their act together and replenish the feedwater.

In order to keep up with changing demand while simultaneously preserving system performance and efficiency, the feedwater supply has to be able to change quickly and precisely. Enter the modulating feed valve. With a modulating feed valve, the boiler control system responds to increased demand by signaling the valve to open in small increments, letting in just enough water to keep up. When demand levels off, the valve holds its position. Then, as demand decreases, the control system tells the valve to gradually close to compensate. Modulating valves can use one of several methods to regulate the flow of water. They can also use several different methods of actuation to move them.

Some modulating feedwater valves use gate valves. Just like the name suggests, a gate valve has a metal gate inside that slides back and forth perpendicular to the flow of feedwater. The more it slides across the valve body, the less feedwater passes through. Because the gate isn't linear with the flow of water, this design doesn't offer the same level of precision modulation as other designs. It's also more prone to seat leakage over time.

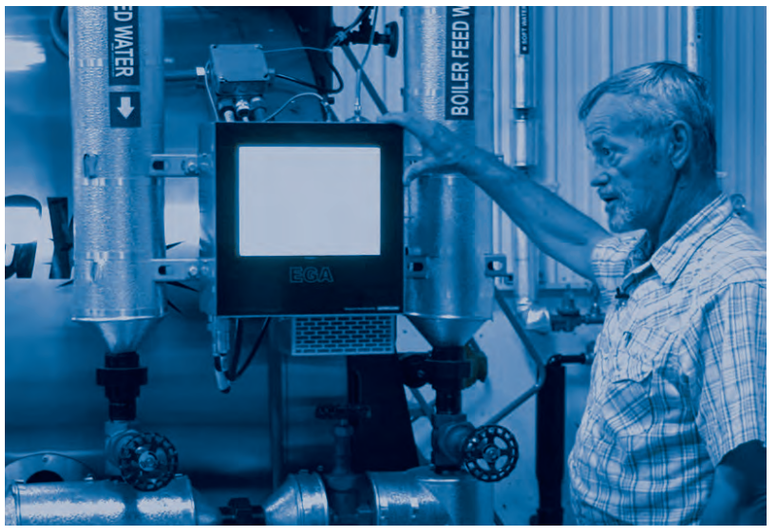
Some modulating feedwater valves use a ball-valve design. In these valves, a solid ball or sphere is mounted inside the valve body. The ball or sphere has a hole running through it in the same longitudinal axis as the water flow. As the ball turns on its lateral axis, the hole rotates into or out of linear alignment with the water flow, letting more or less water through.

Continued on page 7

LOW O2 SHUTDOWN: IN OR OUT?

By Mike Taylor

Boilers have come a long way in a comparatively short time, and today's boilers operate more efficiently, precisely, and reliably than ever before. One of the most important advancements has been the ability to monitor and regulate oxygen in the combustion process. Ideally, a boiler's fire side should take in just enough air to maintain the burner flame, with very little excess oxygen passing out through the stack. That's because oxygen absorbs heat. The more oxygen you have leaving your stack, the more heat you're losing to the atmosphere.



The level of oxygen in a boiler's flue gas, therefore, can serve as a key indicator of performance, and it is monitored, controlled, and adjusted through a process known as oxygen trim. By monitoring the amount of oxygen entering the system, and comparing it to the amount of oxygen in the flue, the oxygen trim system can get an idea of how much oxygen is left over after combustion. The system can then automatically open or close the air damper to maintain a set level of incoming air to minimize the excess oxygen in the stack.

For the most part, boilers that operate with minimal excess air are more efficient. However, too little air can also be a problem. If oxygen levels fall below the manufacturer's recommended parameters, it can create a hazardous condition known in the industry as low O2.

According to the ABMA Boiler 307 Combustion Guidelines technical paper, the most intuitive solution to a low O2 situation might not be the best. Currently, many systems are set to automatically shut down when a low O2 situation is detected. However, according to the paper, shutdown is not the right course of action. When oxygen levels drop below 1%, a considerable amount of unburnt fuel will begin to collect. Since automatic shutdowns usually trigger an air purge of the fire side, that will mean that this unburnt fuel will suddenly encounter a considerable amount of oxygen in the incoming air. If any combustion is still occurring, this creates the possibility for an explosion. Depending on the quantities involved, the explosion could be large enough to damage internal components, or cause external parts of the boiler to warp or even rupture.

The paper goes on to suggest that the oxygen levels should be increased before shutdown, to make sure all of the available fuel is burned off before the system begins the post-shutdown fire side purge. This would involve performing a manual shutdown one of two ways. The first method involves decreasing the fuel supply until the oxygen levels come back up to within proper parameters. However, shutting down the boiler in this way requires expertise and training to perform properly. Turning off the fuel too quickly will also create an oxygen-rich environment, and a risk of explosion.

If a technician is not available to perform a proper fuel level shutdown, the second method should be used: the emergency stop button. Once emergency stop is activated, the boiler loses all electrical power. Because of the fail-safes built into the system, loss of power will not only turn off the burners, it will also prevent the purge fans from introducing fresh oxygen into the fire side at any point.

Simply shutting down the boiler at the control won't work, either. When a boiler is shut down at the control, the gas valves still close. However, the system will then automatically trigger a purge, sending a rush of fresh oxygen into the fire side. By following the proper procedure and hitting the emergency stop, that purge won't happen, and no air will be introduced. Incidentally, in a properly built

Continued on page 7

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Boiler Shutdown on Low 02
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HEADLINE: It All Comes Out in the End.

By Steve Taylor

Boiler systems have a fair amount of monitoring equipment built into them to help you fine-tune performance and energy use. One of the simplest and most important parameters to watch is one of the last ones in the system: the stack temperature.

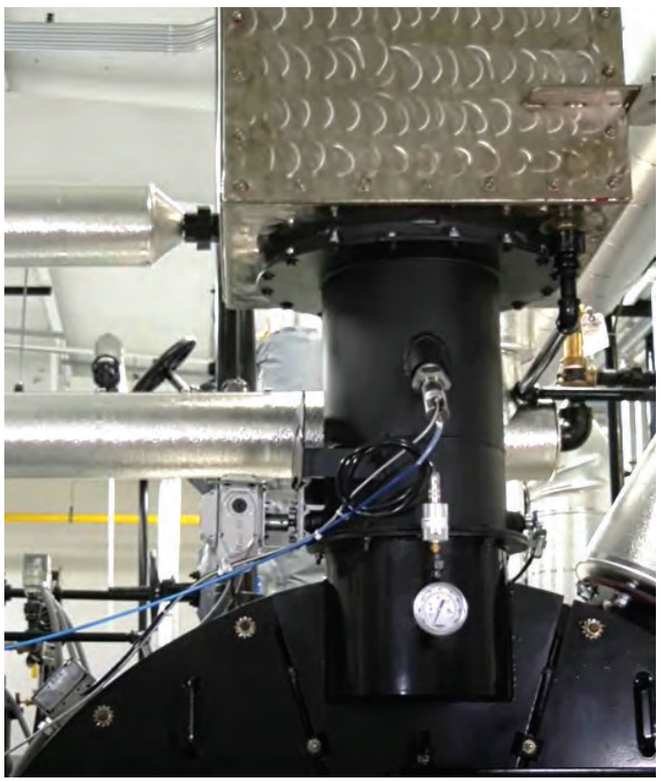
Stack temperature is extremely helpful for two main reasons. First, it can be easily checked by anyone, every day. Frequent checking means that a problem with the boiler will be detected early on, when the daily temperature is compared to the previous days' temperatures. The second reason stack temperature checks are so helpful is because they are a key indicator of a boiler's efficiency and performance.

If exhaust gas temperatures are considerably higher than the boiler's designed operating temperature, that indicates that the boiler system is dumping heat that isn't doing any work. That heat is not converting water into steam, it's just rolling right through the system and heading out into the atmosphere. Unfortunately, that energy still costs money even if it isn't being used.

Elevated stack temperatures are most often caused by two main problems, the first of which is improperly treated water. Whether it's due to a failed water softener or contamination coming back from the process, water impurities entering the feed water can be bad news. As the water converts to steam, the impurities that are left behind begin to accumulate on the water side of the boiler. These impurities can then start to act as an insulator between the water and the fire side. Since the heat isn't transferring as efficiently, the boiler then has to fire at a higher rate in order to maintain proper steam production. That higher firing rate will, in turn, create an increase in stack temperature.

The second main cause of higher stack temperatures also has to do with unwanted accumulation, this time in the form of soot on the fire side of the boiler. As soot begins to collect, it starts to impede heat transfer in much the same way as impurities do on the water side. Because the boiler has to fire at a higher rate to overcome the soot barrier, stack temperatures will go up.

No matter how well-maintained a boiler is, though, there's still going to be some heat loss. The amount of heat loss depends on the condition, age, and design of the boiler itself, but there are actually



a few different ways to increase efficiency and reduce fuel loss in nearly any boiler. For example, a routine tune-up is a great way to save on energy costs by making sure your system is running at peak efficiency. Installing a new burner can often make a big difference, as well. Another solution that can help is upgrading to a control system that doesn't rely on linkages.

If a boiler system runs at over 100 psi, there's another way to increase its efficiency, as well: installing an economizer. An economizer works by routing stack exhaust through a heat sink, which captures that excess exhaust heat and puts it back to work by preheating the boiler feedwater. So instead of venting excess heat out into the atmosphere where it doesn't

Continued on page 7

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796	82,500	2016	Victory Energy Faber	(Low NOx) G/#2	Steam	350	IRI
797	82,500	2016	Victory Energy Faber	(Low NOx) G/#2	Steam	350	IRI
767	75,000	2011	Victory Energy	(Low NOx) G/#2	Steam/SH	750/750	IRI
747	75,000	2000	B&W	(Low NOx) G/#2	Steam/SH	750/750	IRI
791	75,000	2016	Victory Energy	(Low NOx) G/#2	Steam/SH	750/750	IRI
750	70,000	1996	Nebraska	(Low NOx) G/#2	Steam/SH	750/750	IRI
709	60,000	1979	Zurn	(Low NOx) G/#2	Steam	500	IRI
741	60,000	1979	Zurn	G/#2	Steam	550	IRI
795	40,000	1986	Cleaver Brooks	Gas	Steam	260	IRI
634	800	1972	York-Shipley	G/#2	Steam	150	IRI
620	800	1975	York-Shipley	G/#2	Steam	250	IRI
SSB-55	800 XID	2021	Victory Energy	(Low NOx) G#2	Steam	250	UL/CSD-1
SSB-57	600 XID	2021	Victory Energy	(Low NOx) G/#2	Steam	250	UL/CSD-1
SB-139	500	2001	Cleaver Brooks	G/#2	Steam	150	
SB-243	400	2018	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD1
SB-138	350	1994	Cleaver Brooks	G/#2	Steam	150	
SSB-39	300 XID	2016	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB-51	250	2020	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD-1
415	250	1980	Eclipse	#2 Oil	HT/HW	954	IRI
SB-148	200	1995	Kewanee	Gas	Steam	325	IRI
SB-146	200	1995	Kewanee	Gas	Steam	325	IRI

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SWVB3	1500	2021	Victory Energy	(Low Nox) G/#2	Steam	250	UL/CSD-1
SSB-56	1200	2021	Victory Energy	(Low NOx) G/#2	Steam	250	UL/CSD-1
SB-258	300	2013	Cleaver Brooks	Gas	Steam	150	ULs
SB-251	250	2019	Victory Energy	G/#2	Steam	150	UL/CSD-1
SB-255	250	2012	Cleaver Brooks	G/#2	Steam	150	UL/CSD-1
SB-264	175 XID	2021	Victory Energy	G/#2	Steam	150	UL/CSD-1
SB-248	175 XID	2019	Victory Energy	G/#2	Steam	150	UL/CSD-1
SSB-53	175 XID	2020	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB-52	150	2021	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD-1
SB-257	150	2021	Victory Energy	G/#2	Steam	150	UL/CSD1
SB-256	150	2019	Victory Energy	G/#2	Steam	150	UL/CSD1
769	150	1998	Precision	Electric	Steam	150	UL
SB-260	100	2010	Johnston	Gas	Steam	150	UL
SB-254	100	2020	Victory Energy	G/#2	Steam	150	UL/CSD-1
SB-259	100	2021	Victory Energy	G/#2	Steam	150	UL/CSD-1
SB-262	100	2021	Victory Energy	G/#2	Steam	150	UL/CSD-1
SSB-54	100	2020	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD-1
SB-241	100	2008	York-Shipley	Gas	Steam	150	UL
SB-237	70	2016	Victory Energy	G/#2	Steam	150	UL/CSD-1
SB-238	70	2016	Victory Energy	G/#2	Steam	150	UL/CSD-1
SSB-35	70	2016	Victory Energy	(Low NOx) G/#2	Steam	150	UL/CSD-1
SB-263	50	2021	Victory Energy	G/#2	Steam	150	UL/CSD-1
SB-261	50	2016	Victory Energy	G/#2	Steam	150	UL/CSD-1
SSB-45	50	2019	Victory Energy	G/#2	Steam	150	UL/CSD-1

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Continued from Pg 1 - Modulating Feedwater Valves: The Method behind the Movement

Other types of modulating feed valves use a globe valve, which features a disk or globe presses against a corresponding valve seat on the other side of the valve body. As the globe and seat move farther apart, they let more and more water pass through. Because globe valves operate parallel to the water flow, they allow for greater precision in the regulation of feedwater.

The valve type that WARE chose for the Mod-V valve, however, is the modulating V-port ball valve. Inside, a sphere is mounted in-line with the flow of water. That sphere moves against V-shape insert and rotates into and out of position to let the water flow at a desired rate, or seal the flow off entirely. Modulating V-port valves have several advantages over other types of valves, all of which make it the ideal solution for feedwater control. Modulating V-port valves offer a lower pressure drop when they're operating, allowing water to flow unrestricted. However, when they're shut off, modulating V-port valves provide a bubble-tight seal that prevents water leakage even when sealed for a long time. Because of the way they're designed, they also permit easy shutoff even at high pressures.

When a modulating feed water valve is installed in a functioning boiler system, it doesn't really make sense to have someone standing there turning the handle every few seconds to match feedwater demand. That's why most modulating feedwater valves are controlled automatically, by modulating motors. Just like the name suggests, a modulating motor has the ability to move to any position in its full range of motion and hold there. This makes them ideally suited to open and close the modulating valve based on real-time demand requests sent by the boiler control system.

Modulating motors may be powered pneumatically or electrically, depending on the force needed to turn the valve, and the voltage or air supply available in the boiler room. Incidentally, electrical modulating motors typically operate with a 4-20 mA or 0–135-ohm control signal. To make sure the modulating motor and valve work together like they're supposed to, modulating motors are calibrated according to range of motion, called "stroke", and modulation speed. Feedwater valves should always be properly sized based on the boiler size, the operating pressure of the boiler, and the supply pressure and flow of water through the piping and valves. WARE can help with proper sizing so that your boiler system is matched to your unique processes and demands.

When it came to choosing a modulating motor to link to the Mod-V modulating valve, WARE went with Honeywell. Not only are they robust, reliable, and accurate, they're also a widely available industry standard part. WARE has been in the boiler business a very long time. When they release a new piece of hardware, it's a safe bet that a lot of thought and expertise went into it. That's the case with the WARE Mod-V modulating feedwater supply valve. It's built well, with extremely high-quality materials, and very tight tolerances. And it's built to offer every feature it takes to get the most out of a boiler system. If you would like to learn more about the WARE Mod-V modulating feedwater valve, or have one installed, please contact WARE today.

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Common Problem Fix for Boiler Feedwater Valves

Continued from Pg 2 - Low O2 Shutdown: In Or Out?

boiler system, the emergency stop button should shut down every boiler in the room, for an added level of safety.

Modern oxygen trim systems, like the ones made by Autoflame, bring a new level of precision to the regulation of combustion. They can respond in real time to changing conditions, adjusting both fuel and air levels to maintain the set proportion. Some boiler operators choose to take advantage of this by running their boilers at 1% oxygen to maximize efficiency. However, this leaves no margin of error to adapt to rapid changes, and could very easily trigger a low O2 situation. A properly-run boiler should aim to maintain around 3% oxygen to get the best mix of efficiency and safety.

Continued from Pg 3- HEADLINE: It all comes out in the end.

do anyone any good, that heat is doing what it's supposed to. Which means you're getting more work for your money.

An economizer isn't ideal for every system, however. In some situations, installing an economizer will actually lower the stack temperature too far. If the exhaust temperature drops below the outside dew point, condensation can form. That condensation can then run back down the stack and into the rest of the exhaust system, where it can cause corrosion and rust. To combat this, some stacks are made from stainless steel, allowing them to operate with a lower stack temperature.

No matter what's going on in the stack, WARE has the skill and expertise to make it better. Contact us today to find out what we can do to help your boiler get more useful steam out of every energy dollar.

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