SYSTEMS & SOLUTIONS

Zoning a Steam System? Watch Out!

"It's a shame most people still have to learn the hard way, isn't it?" The Old- Timer blew on his hot coffee and took a quick sip. He let the mug warm his calloused hands as he stared out the window for a moment.

"You'd think he would have known better than to put those valves on that old steam system, " he said, shaking his head in sad resignation. " I hate to see nice guys having problems, but, hey, that's what happens when you don't look where you leap. "

He was talking about a mutual friend who had installed motorized zone valves into a gravity return, one-pipe steam system and was now having problems.

"Did he call here first?" The Old-timer asked fixing us with a steely eyed glance.

"No," we answered. "We would have told him what to watch out for. "

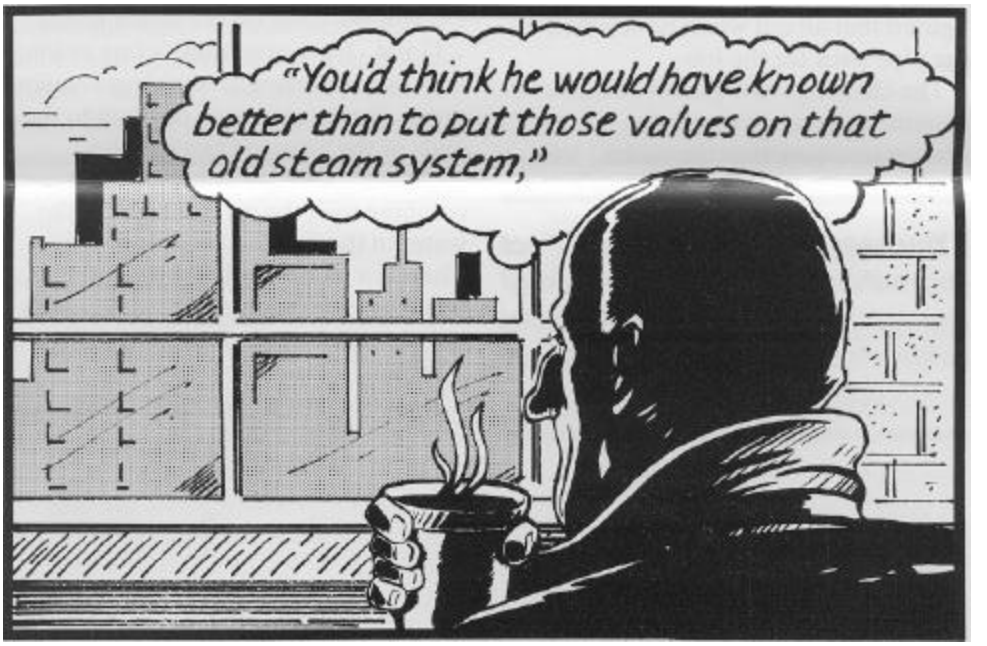
The Old-timer looked out the window again. "That's part of the problem, you know, " he said almost to himself. "Not enough people ask for advice. They just rush into things without thinking them through. " He shook his head and chuckled. "But things weren't much different in my day, I suppose." He took another sip of coffee. "Is the customer complaining a lot? "

"He sure is! He calls every morning and hollers." we said.

"I'm not surprised," the Old-timer said. "That's when I expect you'll hear the loudest banging. I figure right around mid-morning when the zone valves open for the second time. "

"That's right."

"It's a shame he didn't call and ask

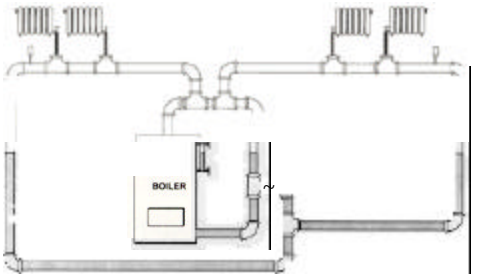


for advice *before* he got involved in the job."

"It is a shame," we agreed.

What We Probably Would Have Told Him

The one-story building our friend worked on had a gravity return, one- pipe steam system. Two mains left the boiler and headed in opposite directions. **It** looked like this.



The owner of the building rented space to two tenants, one on each side of the building. Since the tenants were on different schedules, the building owner decided to zone the system, hoping to save fuel. He called our friend for advice, and our friend recommended the motorized zone valves.

Now, if our friend had called here first, we would have told him to proceed slowly and consider the entire system, not just the motorized valves. You see, motorized valves affect more than just the supply side of the system. They also make a big difference in the way condensate returns to the boiler.

Take a look at the diagram of his system. It's a gravity return system so all the pipes connect in one big loop. Can you see how there's a natural balance between the supply and return

sides? In a way, it's like a scale.

As soon as the water begins to boil, the slightly higher pressure in the boiler moves the steam out into the piping, toward the main vents and radiator vents. By the time the steam reaches those far points, however, it will have lost some of its pressure because of the friction it produces as it moves through the pipes.

You don't need much pressure to get from the boiler to the far points. Usually, you can do it with just a little more than 1 PSI. The design engineer figured that all out when he selected the pipe sizes for the job.

The challenge of a gravity return system, however, is to get the condensate back into the boiler. You

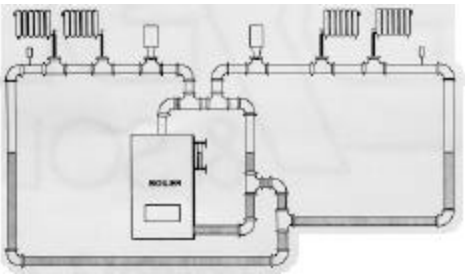
"You see, motorized valves affect more than just the supply side of the system. They also make a big difference in the way condensate returns to the boiler:"

see, you've lost pressure along theway so there's not enough left over at the ends of the mains to overcome the pressure in the boiler. To supply extra pressure, the design engineer allowed for a certain amount of vertical "stacking space" between the boiler water line and the end of the lowest horizontal steam main. As the returning condensate stacks up in this vertical pipe, it exerts a downward pressure on the boiler. This pressure combines with the " leftover " steam pressure at the end of the main to put condensate back into the boiler.

As you can see, this is a delicate balance, and anything that changes the condition of either the vertical "stacking" space or the "leftover" steam pressure can affect the way the system operates.

Design engineers frequently put boilers in pits to ensure there would be enough "stacking" space for gravity return of the condensate. They also carefully sized their steam mains to make sure there wouldn't be too much pressure drop as the steam traveled to the furthest radiator. If there were too much pressure drop, the steam would never make it to the far radiators. The building would heat very unevenly.

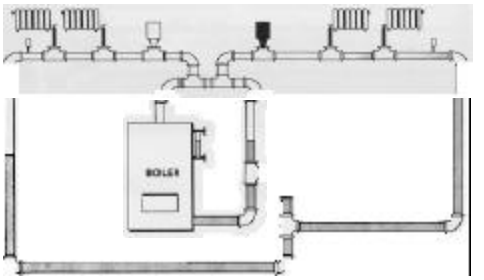
Okay, now let's take a look at what our friend did.



He added the two motorized valves. Do you see them on the steam mains?

Good. Now everything's fine as long as those motorized zone valves remain open. Steam can reach through to the ends of the runs and provide the "leftover" pressure you need to combine with the static weight of the water in the vertical "stacking" space. There's a natural balance, and condensate will return to the boiler by gravity ***-as long as those zone valves are open.***

But look at what happens when one of those valves closes.



With the valve closed, we suddenly have no "leftover" pressure in the return. All we have is the static weight of the water in the vertical "stacking" space, and that's not enough to overcome the pressure inside the boiler.

Suddenly, your " scale " is unbalanced and water backs out of the boiler and up into the horizontal steam main of the closed zone. That's when the trouble starts.

Water Level Problems and the Anvil Chorus

As boiler pressure pushes return water up into the horizontal returns, the boiler will do one of two things: it will either short-cycle on a low-water condition, or it will call on an automatic water feeder to add water to keep the burner running.

If the burner shuts off on low-water because the water is backing out of the boiler, you'll quickly have no heat in the zone that's calling for heat. The burner is off so the pressure drops. Once that happens, the water will naturally return from its perch up in the horizontal steam mains of the "off" zone. The burner will restart and the cycle will begin again. As long as one zone valve is open and the other is closed, the burner will short-cycle, and that's not good for either the burner or you.

Now, if there's an automatic water feeder, the burner won't short cycle, but when the "on" zone reaches the finally shuts off, the trapped water from the " off" zone will return and flood the boiler.

Then, on the next cycle, water will leave the flooded boiler with the steam and create water hammer in the mains. The steam will also condense in this carry-over water and never reach the furthest radiators. You'll wind up with uneven heat to go along with your water hammer.

To make matters worse, if the "off" zone should call for heat while there's pressure in the boiler, the steam will race through the opening valve and meet with the water that's sitting in the horizontal steam main. That's when the building begins to bounce! You'll have an incredible amount of water hammer, and you'll probably damage that expensive motorized zone valve while you're at it.

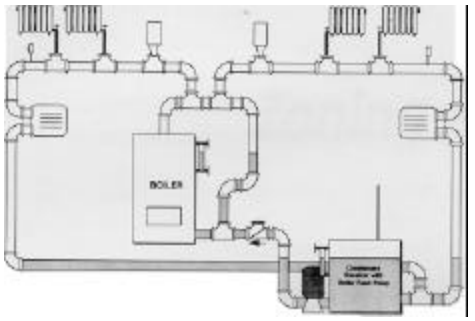
When faced with this problem, a lot of guys will add a check valve to return. Sure, this keeps the water from backing out of the boiler, but it won't solve your condensate return problem. In fact, it will make it even worse because now the condensate has to overcome not only the pressure in the boiler, but also the pressure drop of the check valve!

Adding a check valve guarantees the boiler will either short-cycle or flood.

Bring On The Boiler-Feed Pump!

The only way around these problems IS either run the boiler at extremely low pressure off a vaporstat (which may not

be possible, depending on how the design engineer selected the pipes), or to add a boiler-feed pump to the system. A boiler-feed pump changes the system from a gravity return, one- pipe system to a pumped return, one- pipe system.



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You'll also need two float & thermostatic traps to keep the steam from reaching through to the boiler-feed pump's open receiver. Those traps have to be larger than normal because they're handling the condensate load from the radiation as well as the steam mains. If the building you're working in is tall, it will probably also have riser drips. These, too, have to be trapped.

None of this equipment comes cheap. Our friend found that out in a hurry, and to make matters worse, he was locked into a low-bidder's price. He'd guaranteed the motorized zone valves would work, and now he was stuck.

Fire-side Problems

Here I S the other side of the problem he ran into: When the design engineer sized the system, he matched the boiler to the radiation, the burner to the boiler, and the distribution piping to the total load the boiler would produce. He sized the distribution pipes so there would be a minimum pressure drop from the boiler to the last radiator. He knew that if his pressure dropped too much, the steam would stop moving before it reached the end of the run and the radiators furthest from his boiler would never heat well.

Now here's a key point that's often missed: In steam work, if you over-size or over-fire the boiler, the velocity of the steam *and the pressure drop of the system* will both increase.

This is very important because let's say you have a 1,000,000 Btuh boiler feeding pipes sized to carry that load at a certain pressure drop. If you install two motorized zone valves, there will, of course, be times when only one is open. The trouble is, the load leaving the boiler continues to 1,000,000 Btuh, but now it's trying to flow through a pipe that's much to small to handle it at the pressure drop the design engineer specified.

So what happens? The pressure drop across the system increases with the increased load in the " on " zone. The greater-than-expected pressure drop causes the water to back out of the boiler and up into the horizontal steam mains. Naturally, this often results in water hammer at the end of the main, even while the zone valve is open!

And remember, a check valve won't-help you.

Staying Out Of Trouble

So, if you zone a system with motorized zone valves, you should also plan on using a boiler-feed pump and steam traps at the ends of the mains and the base of the risers drips. You should also use a modulating burner to meet the reduced needs of the system when just one zone calls. And by the way, we can show you a great way to manage these modulating burners! We make controls specifically for this application.

"In steam work, if you over-size or over-fire the boiler, the velocity of the steam and the pressure of the system will both increase."

You might want to consider zoning your steam systems with thermostatic radiator valves instead of motorized valves. These radiator-mounted, self-contained units take the place of the supply valves on two-pipe steam systems and do a nice job of preventing overheating. They also allow you to set different temperatures throughout the building.

For one-pipe steam, we recommend you use a thermostatic radiator valve between the radiator and the radiator's air vent~ When the room comes up to the preset temperature, the thermostatic radiator valve closes and locks a certain amount of air in the: radiator, preventing the entry of any more steam. You can't use a thermostatic radiator valve at the inlet of a one-pipe steam radiator because the steam and the condensate share the same pipe.

Thermostatic radiator valves, when used with Heat- Timer's MPC steam controller puts you in complete charge of the system. You can control the input of steam based on the outdoor temperature, and you can compensate for heat gain at the same time. It's a nice solution!

Seeing The Big Picture

The Old-timer was putting on his coat, getting ready to leave.

"Gotta go?" we asked.

" Yeah. Lots of things to do today, guys. Thanks for the coffee! "

"Hey, stop by anytime," we said.

He stopped at the door, turned and smiled. "You know, I always enjoy talking with you guys. You don't mind listening to advice from an old man like me." A twinkle lit up his eyes. "Maybe that's why you're so good at solving system problems. You guys see the big picture, you know the value of experience...and you listen. "

The Old-timer made us feel real good that day.

We *Do* Listen.

Do you have a system problem? Are areas of your building too hot or too cold? Are your fuel bills higher than you think they should be? Are you looking for ways to gain control over your system?

Then talk to us. At Heat-Timer, we take the time to listen to your system problems. We specialize in creative solutions to tough problems, and we love a good challenge.

Call anytime, or stop by when you're in the neighborhood. We'd love to st1are a cup of coffee and some of our ideas with you.

Thanks For Your Continuing Support...

SEE YOU NEXT TIME!