SYSTEMS & SOLUTIONS

WHEN RADIATOR TRAPS FAIL, TROUBLE FOLLOWS

The president of the co-op board was an attorney -a learned man who'd had a lot of experience with this building. It did not surprise us that he had his guard up.

"We can't repair the radiator steam traps!" he practically shouted. "Do you have any idea what that costs? And how e we supposed to get into everyone's apartment. ost of these people work, you know. No, no, that's t of the question! Just make your control work tter."

He was asking the Heat- Timer to solve all the heating problems which plagued this Queens, New York co-op. He didn't want to think about the system. We tried to explain the key role radiator steam traps play in steam distribution, but the attorney was focused. He'd made up his mind -in spite of the facts -and now he wanted his way. In spite of the facts.

This was going to be a tough one.

Looking At The Facts

Thermostatic radiator traps do 3 things: I. They allow air to pass to a downstream vent. 2. They close against steam. 3. They re-open to allow condensate to pass.

How they do all this is pretty interesting.

See that bellows in the drawing (Fig. 1) above. Trap manufacturers partially fill it with a mixture of alcohol and water. Pure alcohol boils at 170 degrees F. at atmospheric pressure. They mix a bit of water with the alcohol to bring the boiling point up to 180 degrees.

The bellows is fully distended when they put the alcohol/water mixture inside. They then dip the bellows into a bath of 200-degree water . That makes the mixture flash into a vapor. As soon as that happens, they seal the bellows with solder \ and remove it from the hot water. As the now-trapped vapor cools and condenses, the bellows pulls in on itself because no new air can re-enter it. The manufacturer then places this normally open bellows in the trap body.

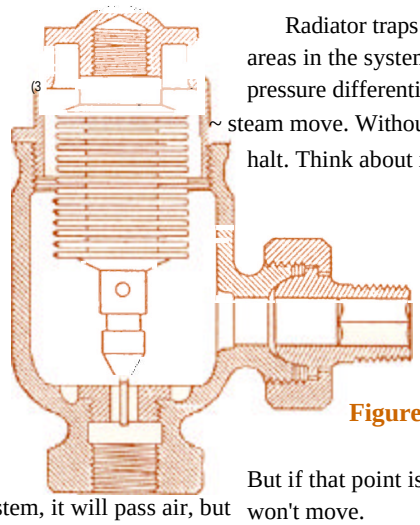

Figure 1

Once installed in a system, it will pass air, but steam will cause the alcohol/water mixture to flash again into a vapor. That .'flashing" pushes the bellows out and closes the trap.

"Radiator traps...establish the pressure differential that makes steam move. Without them distribution grinds to a halt".

As the steam condenses in the radiator , the alcohol/water mixture also condenses inside the bellows. The bellows shrinks & the trap opens to release the condensate.

It's a simple cycle, one that goes on thousands of times a year without anyone notici But in doing these three things, the radiator trap also setting up the conditions steam needs to mo from the boiler to the radiators.

Radiator traps create high- and low- pressure areas in the system piping. They establish the pressure differential that makes ~ steam move. Without them, distribution grinds to a halt. Think about it. If there's steam pressure on both the supply and return sides of radiator, how can air get o of the radiator? It can't. Ar if there's air in the radiator steam won't enter. Remember, a trap's first job is to vent air to a point downstream of itse But if that point is under steam pres- sure, the ai won't move.

And the radiator won't heat -no matter how much you adjust the Heat-Timer.

How Long Do Radiator Traps Last?

Most trap manufacturers claim about three-t five years. After that, the elements will have fail

Why this happens is easy to understand if you stop and think about how many times a thermostatic radiator trap opens and closes over the course of a heating season. Let's take that Queens, New York co-op apartm building as an example.

This one was a two-pipe, pumped- return system. The Heat- Timer turns the

boiler on & off based on the outdoor temperature. The system "sets-back" at night.

In New York City, the heating season runs from October through March for a total of about 182 days. If the system in this co-op shuts down every night for eight hours, they'll be generating steam for a total of 2,912 hours per heating season (182 days X 16 hours per day).

But let's face it, the boiler's not going to be running during all that time. The Heat-Timer will sense the outdoor air temperature and run the boiler for only a fraction of each hour. The colder the day, the longer the run time, and vice versa.

"Over...3 years, (a trap) will have cycled more than a half-million times. After 5 years, nearly 900,000 times"!

To be conservative, let's say the average run time per hour is 20 minutes out of an hour. That corresponds to an average outdoor air temperature of 42-degrees.
That means, on average, the co-op will be making steam for a total of 970 hours per heating season.

Now when the steam is up, each radiator trap will cycle open and closed about three times a minute. By the time the heating season ends in April that trap will have gone through its paces about 174,600 times. Over three years, it will have cycled more than a half -million times. After five years, nearly 900,000 times!

That's a lot of wear and tear on a thin metal bellows. Simple metal fatigue alone will kill it after a few years. But then there's more than metal fatigue to consider, isn't there? There's dirt, water hammer, back pressure in the returns, the corrosive nature of the condensate -in short, the trap element has to face the real world!

That's why most trap manufacturers place the life expectancy of the average thermostatic radiator trap at 3 to 5 years.

The people in the Queens co-op last changed their radiator traps in 1952. Is it any wonder they were having problems?

Now it's true that trap manufacturers design their traps to fail in the closed position. That's why they fill them under vacuum conditions. The theory is that when the trap fails, the radiator will stop heating and the tenant will complain. Then someone can fix it.

The reality, however, is that most trap elements get bashed into submission by water hammer, cocked off -center of their stems and fail wide open. So nobody notices a thing.

Sometimes, however, a trap will fail closed and cause the radiator to go cold. If the Heat -Timer sensor is connected to that radiator's return, it will never sense the presence of steam. The boiler will run for- ever -or at least until the outside air gets warm enough to shut it off.

Any way you look at it, radiator traps are crucial.

So Why Aren't Radiator Traps Maintained?

Well, cost *is* a big factor .1f nobody notices anything, why spend the money? The radiators still heat. In fact, most of them overheat! Sure, the system is noisy, but this is steam. And when it comes to steam, people think banging is normal.

It's not.

Bad steam traps kill steam distribution, but in a co-op, only those with no heat complain, The folks who have heat don't complain. And most of the time, they don't want to share in the expense of getting heat to their neighbors.

"Let the superintendent adjust the Heat-Timer," they say. "That's the control that's supposed to bring heat to everyone."

They're not seeing the system. Access is another problem. That attorney at the Queens co- op didn't have to remind us "Most of the people work, you know." We knew that. We run into it all the time. It's not easy gaining access to apartments.

Nevertheless, there's no getting around trap maintenance if you have a two-pipe steam system. It simply ~ be done if you want the system to work quietly and economically. Think about it. If the traps failed closed -if the folks had no heat at all -they'd let someone in their apartment to fix them, wouldn't they? You bet they would. Unfortunately, most thermostatic traps fail open. And they continue to heat. That's a shame because it leads to even greater problems.

Bad Radiator Traps Kill Good Radiator Traps

Here in Figure 2 (below) we have two radiators which share the same supply and return lines. The trap serving radiator #I has failed and is now passing steam into the common return. Radiator #2 is filled with air which entered the system during last night's setback cycle Its trap is working, but steam won't enter the radiator. Can you see why? Steam gets to radiator #I first and passes into the common return before the air can get out of radiator #2-:-The resultrNumoerns-1iot, Number 2 is cold even though it's the one with the good trap! Air can't get out of Number 2 because there' s no difference in pressure between the supply and return lines.

The superintendent goes up to investigate. Thinking it might be a bad trap element, he removes the cover from the trap. A gush of air blows out of the trap body and steam rushes toward the trap from both ends. This is natural because by opening the trap, the super created a low- pressure zone. Since steam always travels from high pressure to low, it heads toward the open trap.

The super doesn't think about this, though. He's delighted he has heat! He's thinking the trap element was bad and that's why the radiator didn't heat. After all, the radiator's hot now, isn't it?

So he changes the element, but the very next day (after the overnight set-back cycle) the tenant calls him again with the same complaint: No heat.

"They sure don't make elements the way they used to," says the super. "They must have sent me a bad batch." He complains to the board president who takes it

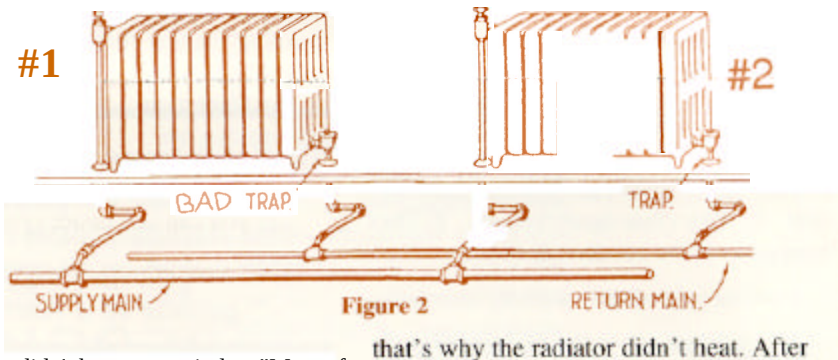

Figure 2

up with the heating contractor, who takes it up with the supply house, who takes it up with the rep, who takes it up with the manufacturer. And so on.

So the super gets an idea. "I'll add a one-pipe steam air vent to the radiator," he says to himself. "That should cure this air problem once and for all!"

He installs the air vent and, sure enough, the radiator gets hot all the way a- cross. The tenant is now warm, but not completely happy. He has this annoying noise he never had before. It wakes him up in the morning. His pipes never banged
like this before the super added that vent. "What's going on?" he asks.

"Hey, it's a steam system," the super answers, “What do you expect?”
See the problem? By adding the airvent, the super created a low-pressure zone. Steam entered the radiator and heated it all the way across. The condensate formed as the steam gave up its latent heat to the cold metal and dripped to the bottom of the radiator. The trap element cooled and opened, but unfortunately, there
was steam in the return line from radiator #1. It, too, sensed the low-pressure zone created by the air vent. The steam shot up the half-inch return line and battered the new element into oblivion.

See? Bad traps kill good traps. And they go about it in a very noisy way.

Bad Traps Make You Raise The System Pressure

Without working radiator traps, your steam distribution goes to pot. When this happens, we can guarantee you someone will raise the Presuretrol settings in an attempt to "push" the steam to the cold radiators.

Now, high steam pressure does several bad things to you:

1. It compresses the air that's trapped in the radiators. This will heat the radiators a bit further, but never all the way across.
And never well.

2. It overheats the radiators that are al- ready getting hot. This is because as you raise steam pressure, you also raise steam temperature.

We size steam radiators to heat the space they occupy with a bit less than I-psig pressure. As you raise the pressure, you increase the amount of Btus coming out of that already-hot radiator. The tenant's response is usually to open the window. What a waste!

3. Because of its higher boiling point, higher-pressure steam creates "flash" steam in the returns. This slows the return of condensate from the system by creating back- pressure. Slow returns create water-level problems in the boiler. Flash steam also results in water hammer. To make matters worse, flash steam can show up at the condensate or boiler-feed pump's receiver vent. That might make someone add a "Master Trap" at the inlet of the receiver. This never works.

4. High steam pressure wastes fuel. Lots of fuel.

Bad Traps Lead To Longer Firing Cycles

When air gets trapped in the radiators, they stay cold (or heat very poorly). But - the mains can still get hot because air will escape through the main vents or the condensate or boiler-feed pump's receiver
vent. The thermister-type heat sensor which tells the Heat-Timer when to begin its countdown to shut-off might be installed in the right place -until the traps go bad that is. The sensor will still "feel" heat at the main as it always did, but the steam is now by-passing the radiators.

The superintendent might try to "fix" things by adjusting the Heat Adjustment Dial on the Heat- Timer. This will make the boiler run longer, but it won't help get the trapped air out of the radiators. And now that the run cycle is longer, the folks who were getting heat before will get even more now. So they'll open their windows even wider.

Unfortunately, the Heat- Timer usually gets blamed-for these problem. It, after all is supposed to control the comfort level in the building.

But you have to have a healthy system before you can talk about system control.

Bad Traps Kill Vacuum Pumps

Vacuum condensate pumps speed distribution by pulling the air out of the sys-tem. Usually, the design engineer will down-size all the pipes and steam traps by one notch when he plans on using a vacuum pump. This means that once it's a vacuum system, it will always be a vacuum system. You can't run it properly without that vacuum pump.

But bad traps kill vacuum pumps be-cause they allow steam to reach through to it. No pump can pump steam -especially a vacuum pump. So when the traps go bad and the vacuum pump fails, steam distribution goes out the window.

Once again, someone might try to make up for the lack of control by either raising the system pressure or adjusting the Heat Adjustment Dial. Either "remedy" leads to a dead end.

That's because they're treating the symptoms, not the system.

Heat-Timers Save Energy ... If You Let Them.

By sensing what's going on inside and outside a building, a Heat- Timer control can go a long way toward getting a handle on energy costs. But the Heat- Timer is a member of a team. It plays a very important role, but it can't get the job done a- lone. There's no getting around steam-trap maintenance. It simply must be done.

Check your radiator traps with a ther-mometer or similar temperature-sensing device. There should be about a 20-degree temperature drop across them. Keep in mind, though, that the higher the pressure, the higher the inlet temperature will be. In a system operating at 3 psig, the tempera- ture at the outlet side of the radiator trap should be about 200 degrees.

Don't bother taking temperature read-ings across F&T traps, though. In a heat-ing system, there won't be a temperature drop across an F&T trap. We'll talk more about this as well as the importance of main vents in our next issue.

YOUR OPINION IS IMPORTANT TO US

How do you like Systems & Solutions so far? We'd love to hear from you. And if you have a friend who should be on our mailing list, let us know. There's no charge for Systems & Solutions; it's our way of saying "Thanks!" to you, our valued customer. We appreciate your business and your support.

If you have a question you' d like us to address, drop us a line.

SEE YOU NEXT TIME!