

SYSTEMS & SOLUTIONS

What "The Old-timer" Knows About Sizing Steam Boilers

Around here, most of us just call him The Old-timer. He stops in from time to time

to have a cup of coffee and share a story or two.



He's seen a lot over the years, been in more basements than most, and made

enough mistakes to know you

should learn from each one. The Old-timer's a magna cum laude graduate of the School of Hard Knocks.

He appreciates the value of patience and he understands the importance of seeing the whole job, not just the parts. We're always happy to see him.

He came by the other day to tell us about this steam job he'd been on. You see, a heating contractor had been having some problems with the owner of a 30-unit apartment building and, well, why don't we just let The Old-timer tell you in his own words...

"Heat loss don't matter! Not when it comes to replacement steam boilers anyway. But this guy didn't realize that.

The Contractor Meant Well

"It started out pretty innocently. The guy wanted to do right by the owner- get the efficiency up and save him some fuel. The old boiler was just about shot and, naturally, it was winter -the time when most contractors have the least amount of

time and the most amount of troubles.

This guy was hurrying when he should have been taking his time. But that happens to us all.

"Anyway, the owner's biggest complaint had been about over-heated rooms. People had their windows open all winter long. You couldn't blame the tenants, though. You know how heating men used to size steam radiators? Rule of thumb. It was quick and easy, sure, but it usually gave them about thirty percent more heat than they needed on the coldest day of the year. Every other day, they roasted.

"I figure back then, the heating men

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wanted to make sure their customers didn't complain about the heat-even if they had the windows open! This place was definitely sized by one of those guys.

"So the building owner says to the contractor, 'There's no sense in making all these radiators hot all the way across. If you do that, my tenants will just keep opening the windows. Why don't you just put in a smaller boiler? That way, I'll have lower fuel bills.' "The reasoning made sense to the contractor. He figured with a boiler half the size of the one that was there now, all the radiators should get hot half way across. Since the radiators

were so over-sized, things should work out just fine. Besides, the owner had spent a lot of money replacing the windows and sealing up the cracks. The heat loss was a lot less now than it was when the first boiler went in. A smaller boiler made sense in a lot of ways.

"So the contractor figured, why not down-size it?" He measured the building and called his local wholesaler for help. The wholesaler did an I=B=R heat 19S5 calculation on the building and came up with a number. Sure enough, it was about half the size of the old one.

"The owner asked the contractor, 'You sure this one is gonna be big enough?' and the guy said, 'Yeah, the wholesaler checked it three times.

Here, look at the calculations. ,

"Figures don't lie, right? So he went ahead and bought it. Took a couple of days to put in.

Tragic Events that Followed

"Well, I shouldn't have to tell you what happened next. The day he fired that new boiler up, about half the radiators in the building got hot. And, naturally, these were the radiators closest to the boiler.

"The contractor figured the problem was being caused by dirt and oil on the surface of the boiler so he skimmed it for a few hours and added a couple of cans of chemicals, but no dice. About half the radiators remained stone cold.

"The guy was in a panic. Remember, this was winter and we're talking about half the tenants with no-heat complaints. They were screaming; so was the owner.

'You told me this would work!' the owner said.

"The contractor didn't know what to do. He went back to the wholesaler. The wholesaler showed him the I=B=R heat-loss calculations again and just shook his head. "Sorry ." The contractor suddenly became the loneliest man in the place.

"So he turned the Pressuretrol setting way up, figuring that would help push the steam out to the end. But that didn't do a thing because when a boiler's undersized, it's never gonna build pressure. Besides, what the heck does steam pressure have to

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do with steam heating in the first place? But like I said, he was in a panic so he kept turning the Pressuretrol up higher and higher. He told me he thought something was stuck in the pipes. But there wasn't anything stuck in those pipes. He was just running out of steam, and he was never gonna build pressure anyway because the boiler was too small. But he didn't know that so he cursed the Pressuretrol and the boiler.

Grasping at Straws

"Then he tried running the burner longer. He set the Heat Adjustment Dial to run the burner on a longer cycle. But it didn't work because his heating system temperature sensor was any way out on the system piping. It was gonna take a long time for steam to reach that point -if ever! So the burner ran on and on and the owner was seething. 'You were supposed to save me fuel!' he shouted at the guy. 'This thing never shuts off!' "Anyway you look at it, this guy was in trouble. If he'd tied the Heat-Timer into a Pressuretrol, it wouldn't have known when to start the cycle count-down because it never would have seen pressure. But the contractor wasn't thinking clearly. No, he just cursed the burner and the Heat-Timer.

"The funny thing was, the longer he let the boiler run, the more the building heated. It took an awfully long time, though. But this guy was willing to grasp at any-thing.

"So he kept pushing that Heat Adjustment Dial on the Heat-Timer. The people with the hot radiators had their windows cracked open -just as they always did. They didn't complain much. But the folks at the ends of the building were banging on the pipes. 'Be patient,' he said. 'It's coming. ' " And it was. Little by little. Unfortunately, the burner never shut off.

Fuel usage was hitting an all-time high. "So the contractor figured there must be something wrong with the Heat-Timer. See? That's the dangerous part. He'd made up his mind without thinking it all the way through.

"He'd made a serious mistake by sizing the replacement boiler to the building's heat-). But he made a more serious

mistake by blaming the control for his lack of heat. But once he found something to blame, he stopped looking for the real cause. Sad. "Say, how about another cup of coffee?"

What Went Wrong?

The Old-timer knew that when it comes time to replace a steam boiler, only two things matter: the boiler's ability to produce steam, and the system's ability to condense steam. For a steam heating system to work as it should, those two abilities must match.

In this case, the contractor thought a half-size boiler would heat all the radiators half way. He was wrong. What happened was the steam left the boiler and immediately began condensing on the cold metal (and there was a lot of cold metal out there!). The radiators nearest the boiler heated quickly and well but then he literally ran out of steam. That's why the radiators at the ends of the run stayed cold. No steam reached them.

Why did the burner run so long? Well, the Heat-Timer depended on the heating-system sensor to tell it when the system was entirely filled with steam. Once the sensor (in this case, a temperature sensor) receives its signal it starts the count-down to burner shut-off cycle. In this case, the sensor was way out at the end of the piping. Since the steam was condensing long before it reached that point, the sensor wasn't getting the temperature signal it needed to start the cycle. It might just as well have been in another building!

Moving the heating system sensor to a closer (and hotter) location wouldn't have

helped because the boiler still didn't have enough steam to satisfy all the cold metal in the building. The burner would have shut off, sure, but the contractor would have come up short anyway. Remember, the heating system sensor (be it a temperature, or in some cases, a pressure sensor) doesn't stop the burner; it just tells the Heat-Timer when to start its count-down to burner shut-off. From there, the burner runs for a certain amount of time - the colder the outside air temperature, the longer the run time, and vice versa.

The Plot Thickens

Now when the contractor turned the Pressuretrol setting way up, he couldn't build pressure because the system was condensing steam faster than the boiler could produce it. The only way you can build steam pressure is by storing steam. And if you're storing steam, you're wasting fuel because steam is supposed to move quickly from the boiler to the radiators. Once it reaches the radiators, there's little reason to build pressure. If the steam isn't reaching the radiators and you're building pressure, that usually means you're trapping air in the system. You solve that with air vents.

Steam pressure has very little to do with steam heating. But the contractor didn't know that.

He'd made a serious mistake by sizing the replacement boiler to the building's heat loss.

The other thing he didn't know is at high pressure doesn't make steam move any faster. In fact, high pressure makes steam move slower! And, in this case, no matter what pressure he ran, he still wasn't making enough to meet the challenge of all that cold metal.

He could have played with that Pressuretrol all day long and still wind up with a half-cold building.

When he turned up the Heat Adjustment Dial on the Heat-Timer, he set the burner up to run on a longer cycle. But the heating system sensor, located out in the system piping, still wasn't getting the signal it needed to start the count-down to shut-off because of the small amount of steam he was making. Had he used a

Pressuretrol instead of a temperature sensor it still wouldn't have worked because he wasn't building pressure.

As the burner ran on and on, however, the near-boiler portion of the system piping was getting hotter and hotter. That meant it couldn't condense steam as quickly as it did when it was cold. So after several hours, the steam would make it a bit further out into the building. But at what cost? The windows were open and the burner was still firing.

The fuel bills were higher than ever in this building, but the comical thing was the burner efficiency was wonderfully way up there! If you never strayed from the boiler room, you'd swear the owner had a good deal going here...if you never strayed from the boiler room.

Combustion efficiency has never been, and will never be, more important than system efficiency. You have to take it all in.

The Right Way To Size A Replacement Steam Boiler

What should the contractor have done? He should have ignored the heat loss calculations and measured the radiators. That's often easier said than done, we know, but it's the only sure way to know what you're up against. Let's face it, if you don't know how much metal is attached to the boiler, how can you possibly know how much steam you have to produce? Guessing just isn't good enough.

Right now you might be thinking, "Yeah, but who has time to measure radiators? If I just give the guy what's

Here, suppose the building owner has removed radiation over the years? Remember, the radiators are probably way oversized for the building. People are sweating and opening the windows. Maybe instead of closing valves, he's taken radiators out. It happens. Ever see a capped riser when you're walking around a basement? What do you suppose was there? Ever notice a capped pipe coming up thru the floor? There used to be a radiator there.

If you base the size of new boiler on what's there now, you just might wind up with an oversized boiler. And that can put you in just as bad a shape as the guy with the under-sized boiler. Oversized boilers surge and throw water up into the system, and you might not be able to

down-fire them enough to cure the problem and still have heat.

But that's a subject for another day. So do the right thing. Take your time and measure the radiators. If that's not possible (and if you can verify this) take one floor as "typical" and multiply that radiation load by the number of floors in the building.

Do you know how to measure radiators? There are a number of good reference books (and booklets) available on radiation output. Check with your boiler manufacturer; many of them offer these booklets for free. Ask.

After you've surveyed the radiators. Take the total load in Square Feet EDR (Equivalent Direct Radiation) and add a suitable pick-up factor to accommodate the piping. That will give you the D.O.E. Heating Capacity rating for the boiler, or what we used to call the "Gross" rating.

Nowadays, boiler manufacturers use a pick-up factor of 1.33 to arrive at the D.O.E. Heating Capacity. In other words, they give the boiler an additional capacity equal to about one-third the total radiation load. This "extra" load is for the pipes. Remember, cold pipes act like radiators on start-up. You have to bring them from room temperature up to steam temperature every morning.

More Capacity for Piping Pickup Years ago, boiler manufacturers allowed as much as 60% additional capacity for piping pick-up. That's because, years ago, steam pipes were larger. Larger pipes mean you have more pounds of steel to

in mind when you're working in an old building. The standard 1.33 pick-up factor might not be enough.

Consider, too, that many people are removing old asbestos insulation and not replacing it with other types of insulation. They want to heat the basement, which is fine as long as they realize that steam condensing in the basement is not going to condense in the apartments. Without insulation, the pipes are going to condense a lot more steam than they did before, and that often spells trouble.

Think. Even the boiler that's now serving the building might not be big enough once the asbestos is gone.

Also, while you're counting and measuring radiators, think long and hard about

what's going on if the owner removed some of them. You're only going to count what you see. But that piping might be sized to support a lot more radiation than you're actually counting. In other words, you'll probably need more than the "standard" 1.33 pick-up factor boiler manufacturers use in their catalogs.

Be careful. Talk these variables over with your boiler supplier and ask them to help you make a decision.

Your Heat-Timer Is A Team Player

Like the Old-timer, we've learned from our experience over the years. Steam heating isn't so hard to understand or manage when you treat it like a system.

Approach it as a system. Keep in mind your Heat-Timer is just a member of the Steam Team. It's an important member, but no more important than the boiler, the burner, the piping the vents, the steam traps, the water-level controls and a dozen other factors.

SO WHAT DO YOU THINK?

We're here to help you when you have a problem. And so is The Old-timer. If you have a question you'd like to ask him, jot it down and drop it in the mail. We'll pass it on to him the next time he stops by for a cup of coffee.

And we'll cover it in an upcoming issue of "Systems and Solutions." And remember, if you like what we're doing here, let us know. It's always good to hear from you!

SEE YOU NEXT TIME!
