Hybrid Hydronics

By Dan Holohan

How to add a hot-water zone to a steam-heating system—successfully!

Let's say you own an old house with an antique steam-heating system that whispers to you on cold winter nights and smiles warmly with ornate cast-iron radiators. You like it just fine. Let's also suppose that you're planning a new kitchen, or you want to enclose the back porch and turn it into a year-round sitting room. That new space will want heat, and maybe you're thinking all you'll need is another steam radiator or two. Sure, it's possible to add steam radiators to an old steam system—but it's not so easy. What you're really looking for, though, is a new heating zone, and there's no reason why you have to tie into the old steam piping to get it. In fact, it may be more practical to add a brand new hot-water zone to that old steam system and even put it on its own thermostat.

Here's why. Imagine for a moment that your local heating contractor stops by to take a look at adding steam radiators. "Can you do it?" you ask.

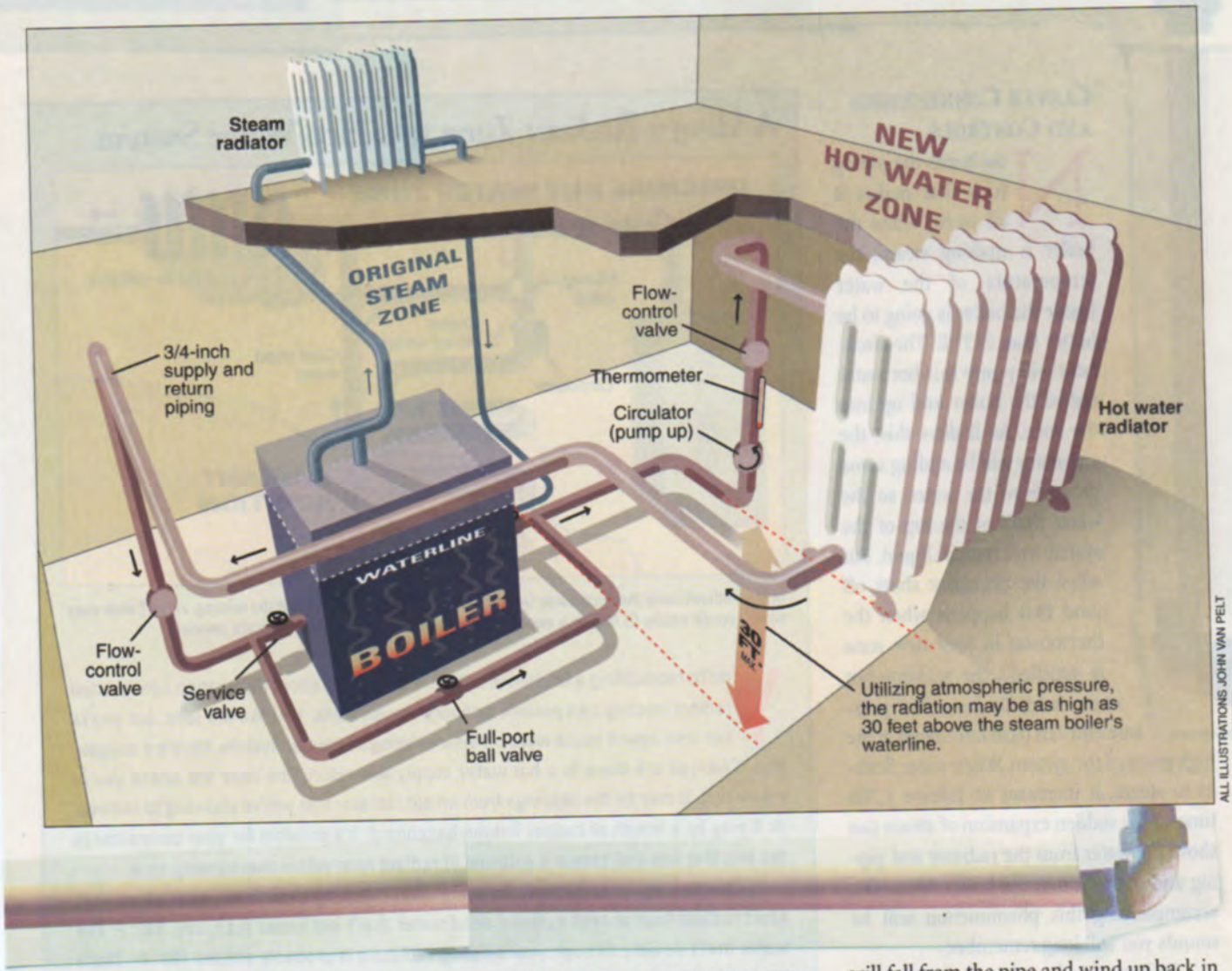
"Not so easy," he says with an expression that conveys something between hopelessness and great expense, one that you, as an old-house owner, know well.

"These pipes are pretty old, and if I touch them," he snaps his fingers, "anything can happen."

Part of the challenge you face here is that most of the folks who understand steam heat happen to be dead. It's possible to add steam radiators to an old steam system, but you first have to make sure that the existing steam mains can handle the additional load. You also have to see if you can tie into that main in the basement with the proper size pipe and still get the correct pitch to the new radiators. Then you have to wonder if the new radiators will be compatible with the old system piping, and what effect all of this will have on the old boiler. Will the new piping bang and spit water when you're done? If so, what then? Creating a new hot-water zone is far from a no-brainer—indeed it's a job that's best left to the pros because they've got the right tools—but it does sidestep these issues.

Like Water from Steam

Here's how a pro can add a hot-water zone to your steam-heating system. First, keep in mind that a steam boiler is like a teakettle. It's partially filled with water and it uses the space above its waterline to make steam, which then races off into the piping in search of a way out (that being the air vents on the radiators and the vents near the ends of the main piping). To add a hot-water zone to that old steam system, the pro will have to grab hot water from the boiler at a point below the boiler's waterline. He'll use a circulating pump to move the water between the boiler and your new radiators, and he'll return the water to another tapping below the boiler's waterline. To ensure good circulation across



ALL ILLUSTRATIONS JOHN VAN PELT

Adding a hot-water zone (reddish piping) to a steam heating system requires tapping into opposite sides of the boiler below the water line. Installation details vary, but avoiding vents is the trick that keeps water in the system.

the boiler, that return tapping must be in a spot on the boiler that's not close to the supply tapping. If the supply and return tappings are too close together, the water will just scoot through your boiler and not remain there long enough to pick up the heat it will need to satisfy your new zone. This is where the tools and skills come in. Securing those tappings in a boiler—particularly an older boiler—can be a challenge. This is not a weekend project.

Now I know you're probably wondering how the water is going to stay in the new zone's piping if that piping is higher than the boiler. To answer this mystery, you'll need to get yourself a glass of water and a drinking straw. I'm now going to ask you to do something that you've probably been doing since you were a kid. Put the straw in the glass of water and then place your finger over the top of the straw and lift it from the glass. The water stays in the straw, right? How come? Because the weight of the air (the atmospheric pressure) pushing the water into the straw is greater than the weight of the vertical column of water that's trying to fall out of the straw. Take your finger off the top of the straw and the air will suddenly have access to both ends of the water column. Gravity will take over and the water will fall out of the straw. The Principle of the Straw will allow you to put a hot-water zone up to the second floor of your house—even if you live in Denver!

The Principle of the Straw is also why you can't have any air vents in your new piping or radiators. If air gets in, the water will fall from the pipe and wind up back in the boiler (and you can't use the circulating pump to fill the zone each time; it doesn't have enough power to do that). The piping to and from the new radiators should ideally be a continuous loop so that the pro can fill it with water before starting up the zone. He'll do this with a purge system, which is nothing more than two shutoff valves and two hose bibbs—one of each on the supply and the return, and below the boiler waterline. To fill the loop he'll close both shutoff valves (installed between the boiler and the hose bibbs) and open the hose bibbs. Then he'll put a hose on one of the bibbs and fill the piping and radiator with water. When water flows from the other bibb, the pro will know that he's done. Then, when he shuts the bibbs and opens the shutoff valves, the water will stay in your new zone, just as it stays in the drinking straw. Pretty cool, eh?

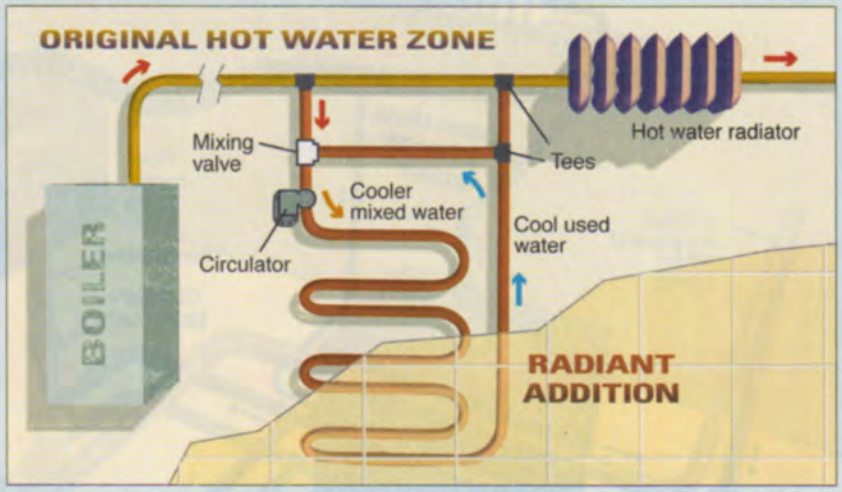
Clever Connections and Controls

Now here's the piping trick that makes it all work. When the boiler is making steam, the temperature of the water inside the boiler is going to be hotter than 212° F. The circulator will pump this hot water out of the boiler and up into the zone. As it does this, the circulator will be adding some pressure to the water, so the water that's at the top of the system will remain liquid. But when the circulator shuts off (and that happens when the thermostat in your new zone is satisfied), the scalding-hot water suddenly loses that pressure and can flash into steam at the high point of the system. When water flashes to steam, it increases in volume 1,700 times. This sudden expansion of steam can shove the water from the radiator and piping and dump it into the boiler. Moreover, accompanying this phenomenon will be sounds you will long remember.

To keep this from happening, the pro will pipe a boiler-bypass line between the return line and supply line of your new hot-water zone. The bypass will allow some of the water that's returning from the radiator to go around the boiler and join the hot water that's leaving the boiler. The result will be water that's about 180° F. (when the boiler is making steam). This piping technique mimics what goes on inside a kitchen sink's single-lever mixing valve. It blends hot and cold water to deliver a mix that's just right—not too hot and not too cold. In your new zone, that blending ensures that the water at the top of the new zone can't flash to steam when the circulator shuts off.

To control all of this, the installer will use three devices. A thermostat in the space will sense the air temperature and start the circulator on a call for heat. The water will move past an aquastat, which is like a ther-

Adding a Radiant Zone to a Hot-Water System



In the radiant zone the circulator (about the size of a man's fist) and the mixing valve (also very small) could easily fit inside a vanity cabinet and be accessible for future service.

You're remodeling a kitchen or a bath. You've read about the unseen comfort that radiant heating can provide to floors—even walls. You like the idea, but you're not sure how it could work off your existing hot water system. Here's a suggestion. Chances are there is a hot water supply and return line near the space you're reworking. It may be the tappings from an old radiator that you're planning to remove, or it may be a length of copper fintube baseboard. It's possible for your contractor to tap into that line and create a subzone of radiant heat within that existing zone.

The trick lies in tempering the water that's flowing though the existing system. Most radiant floor or wall systems need water that's not hotter than, say, 120° F. The water that's flowing through your existing radiators is probably around 180° F. That's too hot for the flooring materials, and you wouldn't be able to walk on that floor with your bare feet. To lower the water temperature, your contractor can use a three-way mixing valve. This valve is similar to the one you probably have in your shower. It takes a portion of the water that's already been through the radiant heat "subzone" into its Cold port. It mixes in a bit of hot water from the high-temperature zone (this goes into the valve's Hot port). It then sends the now-tempered water out to the floor through the valve's Mixed port.

Your contractor will also need a circulator, and this will be on the supply pipe that leaves the valve's Mixed port. The Hot and Cold connections to the valve will hook into the existing system with two standard tees, placed as close together as possible. He'll also use standard installation techniques when he puts the plastic or synthetic rubber radiant tubing under your floor or behind your walls. You'll have warm floors and a room that's comfortable and easier to clean.

The only drawback of a radiant subzone is that it's a slave to the zone to which it's attached. In other words, if the thermostat for that that zone is in the hallway or the master bedroom, then that thermostat is going to control that zone, as well as the radiant subzone. Both the main and the radiant circulator run at the same time. You can't have separate zones with this method of piping. You could, of course, have the bath or kitchen on its own radiant zone, but that would require running pipe all the way back to the boiler room. (Keep in mind that with today's flexible plastic and synthetic rubber tubing this is a do-able, though more expensive, option).

mostat except that it senses water, not air, temperature. If the water temperature is 180° F. or hotter, the burner will not fire. The third device is called a switching relay. Its job is to start the burner if the aquastat senses a temperature below 180° F., and to stop the burner before the boiler can make steam. This allows your new zone to operate independently. You won't have to heat your entire house (with the steam system) when you just want to warm the new space with the hot-water zone. Plus, your steam system will still work off its own thermostat.

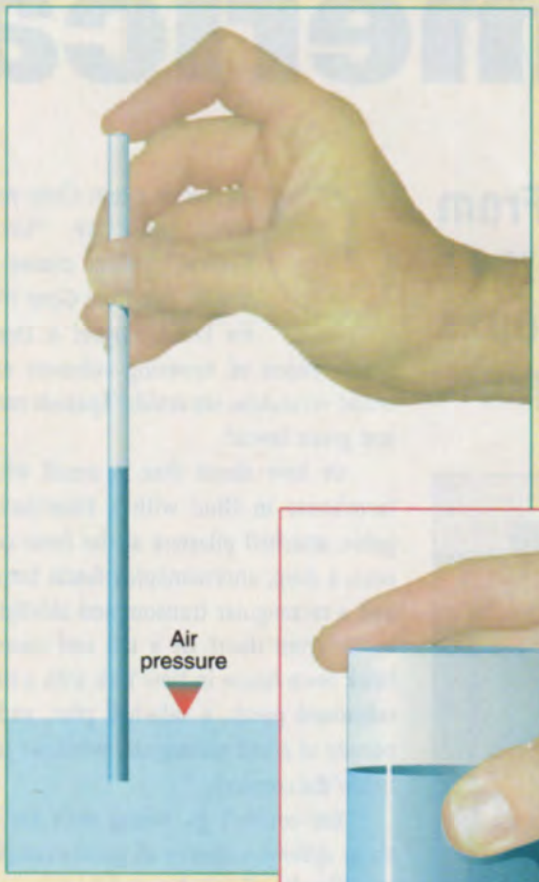
The only other things you'll need to add—and these will go on both the supply and return lines—are flow-control valves. These are weighted (or spring-loaded) check valves that will keep the hot water in the steam boiler from rising (by natural convection) into your new zone when your new thermostat is not calling for heat.

I have to tell you about a few limitations with these hybrid systems. First, there's only so much heat you can take from the boiler before you won't be able to make steam. If you read the boiler's rating plate you'll see the total load listed. It's probably in square feet EDR (Equivalent Direct Radiation). One square foot EDR equals 240 BTUH. You can safely use a third of that total load for your new hot-water zone. Have the pro do a heat-loss calculation on the new space to see what it needs. Don't guess.

The next limitation with this system involves radiant heat. Don't use this piping technique to add a radiant heating zone to your home. The water in a steam boiler is too dirty to be flowing through the tight confines of the plastic or synthetic rubber tubing we use in radiant systems. If you want radiant, the pro can still add a zone off of your steam boiler, but he'll have to use a heat exchanger and a second circulator. This installation means more controls, as well as more money. Finally, pay a bit more to get a bronze-body circulator. It will last longer than an iron-body circulator in the slightly acidic boiler water, and it's your best value in the long run.

So show this idea to your heating professional and talk it over. If you have questions, visit us at www.HeatingHelp.com. Steam heat is nice, and this old-timer's trick can make it even nicer!

THE PHYSICS OF SEALED ZONE PIPING



With a hot-water zone on a steam system, we rely on atmospheric pressure to keep the water up in the zone piping. It's the same effect that keeps water in a straw when you cover one end with your finger and lift it out of a glass of water.

The water won't fall out of the straw because the weight of the air on the water in the glass pushes it back up.

To prove that the effect works for piping, too, which is wider than a straw, try the same experiment with a glass in the sink.

As long as your zone piping is completely sealed, atmospheric pressure will support a column of water about 34 feet high (at sea level).

Dan Holohan, *author and steam-heat specialist, operates www.HeatingHelp.com, where homeowners can get advice from the sharpest heating professionals around.*

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