# Adding a Floor Heating Loop

by John Siegenthaler

One major consideration when installing a floor heating circuit in an existing hydronic system is the need to control water temperature. Most hydronic systems in the U.S. operate at water temperatures necessary for common fin-tube baseboard convectors — usually in the range of 160° to 200°F. In a radiant floor, however, temperatures this high will overheat the slab and possibly cause cracking. Providing lower-temperature water to the floor heating zone, however, may cause flue-gas condensation at the existing boiler.

Large-scale floor-heating projects use motor-operated four-way mixing valves and electronic controls costing as much as $1,000. But small projects, such as one-room additions or bathroom remodels, don't have room in the budget for this kind of equipment. Here are two piping strategies for adding a floor heating circuit that use less expensive, off-the-shelf controls. Both solve the water temperature problem, but in slightly different ways.

## Floor Circuit Sub-Zone

The upper schematic in the illustration will work only when the room temperature of the area served by the floor heating sub-zone is kept at the same or slightly lower temperature than other rooms. The reason is that the floor heating system cannot fire the boiler and operate as an independent zone; the added sub-zone will only deliver heat while the existing high-temperature heating circuit is also operating.

***Downstream tee.*** The floor heating subsystem must also tap into the existing piping near the end of the circuit. If it is connected more upstream, the temperature of the water going to the remaining baseboards might be too low to provide sufficient heat output. This end-of-circuit tee also keeps the return water temperature above 130°F to prevent flue-gas condensation in the boiler.

The new circulator (P2) runs constantly during the heating season. One advantage of maintaining constant circulation in the floor circuits is that it evens out the temperature of the thermal mass; if the circulator ran intermittently, portions of the slab near the beginning of the circuit would be warmer than other parts.

***High temperature limit.*** In this layout, the room thermostat (T2) for the floor heating loop acts solely as an upper temperature-limiting device. If the temperature of water entering the floor circuit gets too high, the aquastat (T1) on the floor circuit supply pipe will cause the zone valve to close. No more hot water will enter the system until the temperature at the aquastat has cooled.

***Balancing the system.*** When the room thermostat in the floor heating zone signals for heat, the electric zone valve (ZV) opens, allowing some hot water to flow into the floor heating circuits. The amount of hot water flowing through the zone valve depends on the setting of the balancing valve (BV). The more this valve is closed, the greater the flow rate of hot water into the floor heating loop.

If this sounds backwards, try thinking of the balancing valve as a flow restricter. Since hot supply water can enter the circuit only at the rate cooler return water leaves, an open balancing valve keeps the water in the floor circuit cool. When the balancing valve is wide open, most of the return water stays in the floor heating circuit, giving up its heat to the slab. The more closed the valve is, however, the more it restricts the flow; more return water goes out into the main loop, so more hot water comes into the floor circuit through the zone valve.

***Valve adjustment.*** Use a full-port ball valve for the balancing valve, and adjust it carefully after the floor slab has warmed up to its typical operating temperature. (A cold slab will give you bad feedback because it will absorb heat too quickly.) Begin with the balancing valve fully open, the zone valve open, and both circulators operating. Rotate the balancing valve handle a little ways toward its closed position while also measuring the temperature of the water supplied to the floor heating circuit. (Put your hand on the pipe, or use a strap-on temperature probe.) Repeat this adjustment in small increments over a period of hours. When the water temperature supplied to the floor has reached its design value (usually 100° to 120°F), the valve is properly set and should not need further adjustment.

I recommend removing the handle from the balancing valve so that the homeowner can't tinker with the valve setting. Should someone open the valve in the hopes of increasing heat delivery to the floor, the floor will actually grow colder. In the opposite case, closing down the valve could overheat the slab, leading to cracks that may telegraph through tile or other brittle finish surfaces.

## Independent Zone

The lower piping schematic shown includes additional components that allow the floor heating circuit to operate as a totally independent zone. A separate circulator (P3) supplies heated water to the floor heating zone, and the thermostat can fire the boiler independently of the baseboard circuits.

***Hot water bypass.*** One crucial element of the piping design is the hot water bypass, which blends hot

boiler water with cooler return water from the floor heating system at the downstream tee. This boosts the temperature of the water returning to the boiler and prevents flue-gas condensation.

Both the existing baseboard and the floor heating circuits are also equipped with spring-loaded check valves. These prevent reverse flow through inactive zones while other zones are operating.

***Controls relays.*** The operation and balancing of the independent floor heating circuit is similar to the sub-zone system. The one exception is that the controls must also enable boiler firing when heat is called for by either the floor heating zone or by any existing baseboard zone. While control wiring for a two-zone system can be put together by an electrician on site, it is easier and probably cheaper to use an off-the-shelf zone relay center. I know of three sources for these: Erie Controls (4000 S. 13th St., Milwaukee, WI 53221; 414/483-0524), Argo Industries (PO Box 8098, Berlin, CT 06037; 203/828-6513), and Bell and Gossett (8200 N. Austin Ave., Morton Grove, IL 60053; 708/966-3700).

In my opinion, the independent circuit design, which costs about $200 more than the sub-zone, is well worth the slightly higher price. Because of the bypass flow, this design can deliver a significantly higher percentage of the total heat output of the system to the floor circuit, without concern for flue-gas condensation in the boiler.

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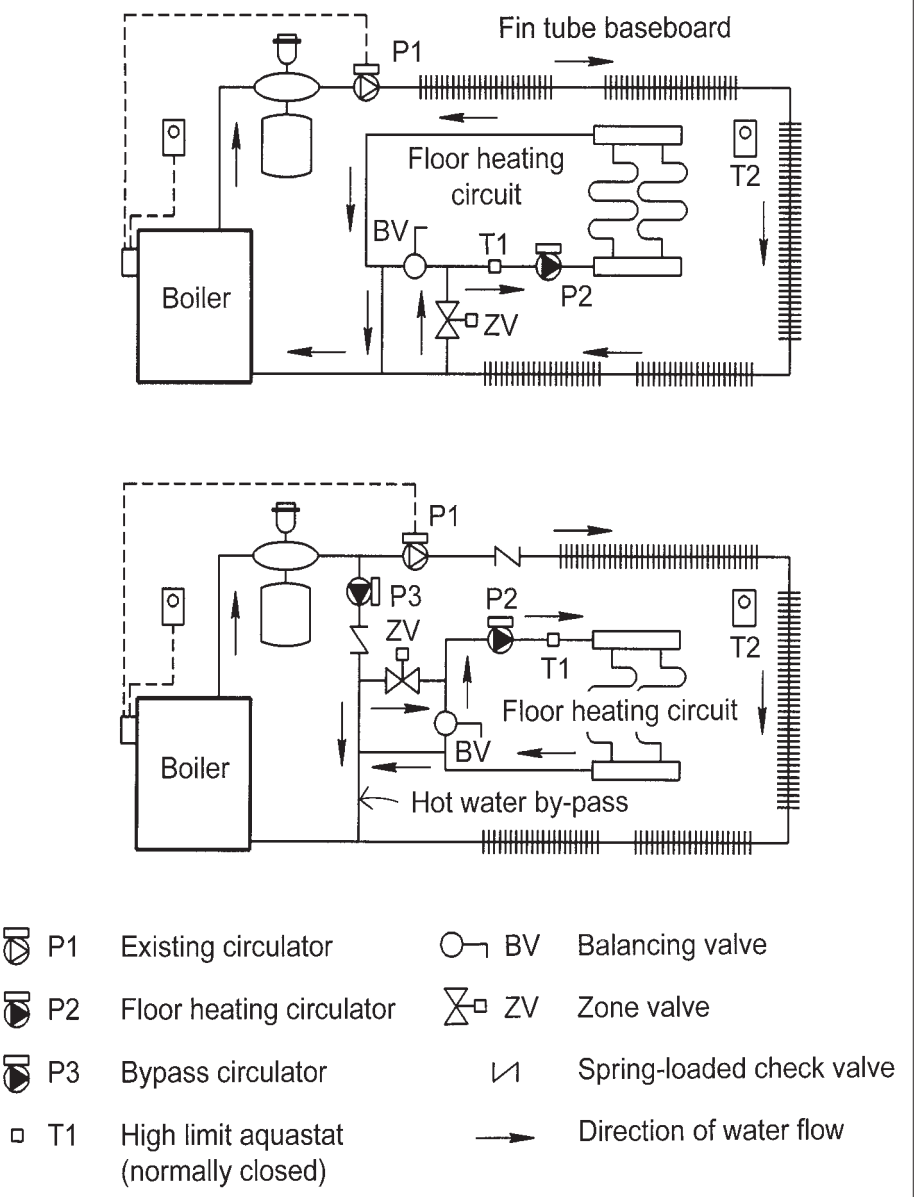
## Options for Radiant Floor Add-Ons




*A sub-zone circuit (top) receives hot water only when the existing baseboard circuit is also calling for hot water; an independent floor heating zone (above) can fire the boiler whenever the area it serves calls for heat. In both systems, a high-limit aquastat (T1) prevents the floor piping from overheating and possibly cracking the slab.*