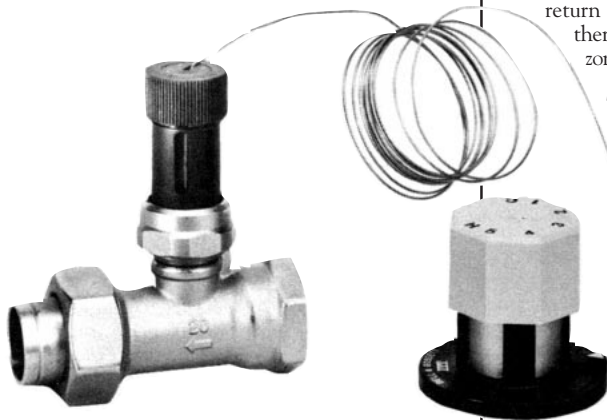


INNOVATIONS IN HYDRONIC HEATING

by John Siegenthaler

New European valves allow
easy and economical
room-by-room zoning



A thermostatic radiator valve (TRV) can control the temperature at each radiator. The most common type has an operator with the setpoint dial mounted directly onto the valve body (top). Also available is a remote setpoint dial, which is connected to the valve by a capillary tube (above).

A modern "one-pipe" heating system combines new control technology with an old hydronic (hot water) piping system. This system offers a number of advantages over conventional hydronic systems. In particular, it is cheaper to create heating zones within a building, and it is easier to control these zones independently.

The heart of the new system is a European-made valve that essentially allows each radiator to be controlled as a separate zone. Not only can you add a single zone at a fraction of the cost required by a conventional hydronic system, but you can also compensate for solar heat gains in a house as the sun moves around the building. Moreover, the system constantly circulates hot water, which improves the response time of the heating system.

To fully appreciate all the advantages of the modern one-pipe system, it's important to first understand the workings of conventional multi-zone and one-pipe systems.

Conventional Hydronic Zoned Heat

With zoned heating, occupied areas in a building can be kept at a comfortable temperature, while an unoccupied or intermittently used area can be kept at a lower temperature to save energy. In a typical zoned residential system, living room, kitchen, and dining areas are grouped in one zone, the bedroom area is another zone, and the basement or garage is perhaps a third zone.

Conventional hydronic systems use a separate thermostat in each zone to control either a circulator or an electric zone valve located near the boiler. When a zone thermostat "calls" for heat, hot water is routed to that zone only (see Figure 1).

Although this type of system allows you to independently control a designated area within the building, it would be cost prohibitive to control each individual room with a separate zone circuit. Such a system would require separate supply and return piping, as well as a control thermostat, wiring, and pump or zone valve for each room.

The Original One-Pipe

During the 1950s, researchers developed a hydronic distribution system in which a single pipe serves as both the supply and return from the boiler. The resulting system has come to be known as a one-pipe system — or as it's called in the trade, a "monoflo" system — after the trademark of ITT Bell and Gossett.

A one-pipe system uses special piping tees known as "one-pipe fittings" to connect each radiator to the main distribution piping. The tees contain an internal baffle that forces some of the water from the main piping into the radiator branch,

and then back into the main (see Figure 2). One-pipe fittings are available from at least two U.S. manufacturers (see "Sources of Supply," at end of article). Retail cost for a 1-inch fitting is about \$6.

If radiator valves are installed, each radiator in a one-pipe system can be "controlled" independently, meaning the temperature of a room is adjusted by manually opening and closing the valve.

Thermostatic Radiator Valves

If the valve could automatically open and close based on room temperature, each room with a radiator would become an independently controlled zone. This type of automatic control valve is known as a *thermostatic radiator valve*, or TRV. TRVs are primarily manufactured in Europe, but are available through a number of distributors in the U.S. Most TRVs have attractive chrome- or nickel-plated brass bodies. Retail costs range from \$25 to \$40 each, depending on size and options.

Unlike standard zone valves used on most American hydronic systems, TRVs don't require electricity to operate. This means there is no control wiring or hardware. The position of the valve stem — and hence the rate of water flow through the valve — is controlled by the thermal expansion of a wax within the valve operator, which responds to room air temperature.

A conventional electric valve simply opens and shuts. The valve must shut before it reaches the setpoint temperature, or the temperature in the room may coast over the setpoint. Depending on the quality and the adjustment of a conventional zone valve, indoor temperatures can fluctuate as outside climactic conditions change.

By contrast, a TRV is a modulating device. As the temperature approaches the setpoint, the TRV shuts down gradually. As a result, TRVs usually permit very stable room temperature control. One manufacturer, Ista Energy Systems, claims their valves can maintain room temperature within plus or minus 1°F of the setpoint temperature.

TRVs come in a variety of configurations. The valve and the operator are separate components that must be assembled and then configured, similar to the way a thermostat is set up. As simple as it sounds, it's important to read the directions if you're not familiar with the assembly; you can't just screw the valve and operator together.

The most common assembly is an operator with a setpoint adjustment dial mounted directly on the valve body. This usually places the dial within a few inches of floor level. Technically, this is a good location to sense the coolest room air temperature. Another assembly connects a remote setpoint adjustment knob to the valve operator with a 6- to 12-foot-long capillary tube. This type of assembly is preferred where people are not willing, or able, to reach down near floor level to adjust the temperature setting. Several

Conventional Three-Zone Hydronic System

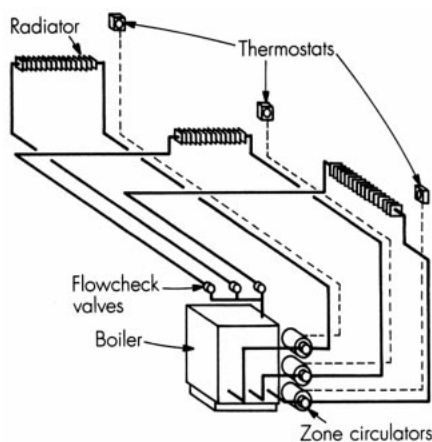


Figure 1. A conventional three-zone hydronic system has a separate thermostat in each zone to activate a circulator located near the boiler. When a zone thermostat calls for heat, hot water is routed to that zone only.

Original One-Pipe System

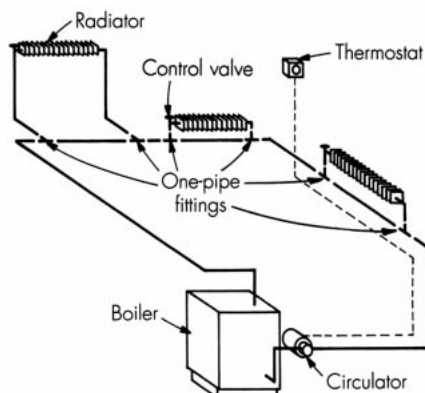


Figure 2. A typical one-pipe system uses special fittings to connect each radiator to the main distribution piping. These tees contain an internal baffle that forces some of the water from the main into the radiator branch, and then back into the main.

Modern One-Pipe System

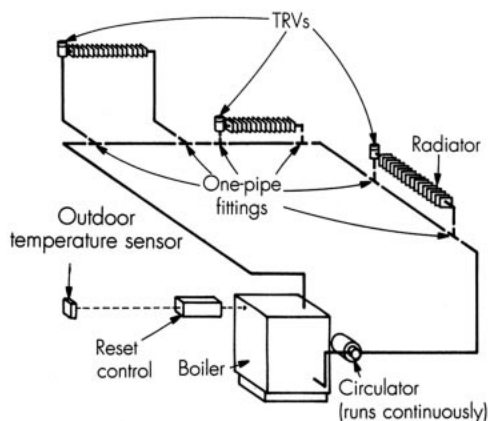


Figure 3. A modern one-pipe system includes one-pipe fittings and thermostatic radiator valves – TRVs. As the air temperature of a given room drops, the TRV opens to allow hot water to flow up through the radiator, until the room temperature returns to the setpoint. The outdoor reset control adjusts the water temperature in the system according to weather conditions, improving system efficiency.

manufacturers offer features such as tamperproof setpoint dials (good when young children are present), upper and lower setpoints limits, and straight or angled valve bodies.

The setpoint adjustment on many TRVs has numbers instead of temperature settings. This is to encourage occupants to set the temperature according to their comfort level rather than to their expectation of what a degree setting is.

Other System Differences

A modern one-pipe heating system differs in two important ways from the typical American residential hydronic system: First, the modern one-pipe constantly circulates the boiler water, and second, it uses an outdoor reset to control boiler water temperature.

Constant circulation means exactly what it says: The system circulator runs 24 hours a day throughout the heating season. This is necessary to ensure that each radiator controlled by a TRV has hot water available to it at all times. The energy demand of the circulator is minimal. However, care should be taken to insulate any piping that passes through parts of the building where heat loss from the pipes might offset the heat load. This might include pipes running through an unheated space, such as a crawlspace or basement, or wherever a large part of the main distribution circuit runs through seldom-used areas, such as a seasonal wing of the house. In the latter case, be sure to use a TRV with a freeze-protection setting to allow just enough water through the radiator to keep it from freezing.

An outdoor reset control responds to the outside temperature and adjusts the water temperature in the system accordingly. During cold weather, water supplied to the radiators is at a higher temperature than during mild weather. This feature matches the output of the heating system to the prevailing heat load of the building and improves the seasonal efficiency of the boiler. The actual control hardware is either built into the boiler or is part of an electrically operated mixing valve device placed between the boiler and the distribution circuit.

Putting It All Together

Put together, the outdoor reset control, continuous circulation, TRVs, and one-pipe fittings produce a room-by-room zoned system that responds to the heat load at each radiator (see Figure 3). During the heating season, water at a temperature appropriate for the prevailing weather conditions is constantly circulating around the main distribution circuit. As the temperature of a given room begins to drop slightly below its setpoint, the TRV on the room's radiator opens to allow water to flow up through the radiator until the room temperature rises back to the set-

point.

Depending on the heating design, you don't need a TRV for every radiator in a room. To justify the cost of a TRV on every radiator, the client must have a need for variable setpoints throughout the house. In some homes this might arise from the clamor of modern life, where children's activities or unusual work schedules create ever-changing occupancy patterns. In other cases, you might want room-by-room control to allow for other heat sources, such as solar gain in a passive-solar house, or a frequently used fireplace or wood stove.

Modern one-pipe systems aren't for every house. In a house where every room will be maintained at the same temperature, TRVs would be a waste of money, and you'd be better off installing a conventional one-pipe system.

However, TRVs do allow flexibility. With a conventional one-pipe system, you can install a single TRV in one room, or one wing, to create a separate zone. If, for example, the house has an in-law apartment, or an enclosed porch that is only occasionally used, you can install a TRV in that one area at a much lower cost than an equivalent two-zone system. ■

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Sources Of Supply

Thermostatic radiator valves:

ISTA Energy Systems Corp.
407 Hope Ave.
Roselle, NJ 07203
908/241-8880

Danfoss
16 McKee Dr.
Mahwah, NJ 07430
201/529-4900

Enerjee
32 S. Lafayette Ave.
Morrisville, PA 19067
215/295-0557

Erie Manufacturing Co.
4000 S. 13th St.
Milwaukee, WI 53221
800/558-3916

Ammark Corp.
12-22 River Rd.
Fair Lawn, NJ 07410
201/796-2500

One-pipe fittings:

ITT Bell & Gossett
8200 N. Austin Ave.
Morton Grove, IL 60053
708/966-3700

Thrift Products Co.
State Rd. 19 S.
Peru, IN 46970
317/473-3728