1. Basic Control Wiring Requirements

1.1 Control selection

(see Control system strategies pages 2-6)

1.2 Zone control

Determine if there are to be individual thermostats for each loop, or if there is to be one thermostat controlling multiple loops. For single-zone multiple loops, allow sufficient space at the manifold cavity to permit the installation of the zone valve.

1.3 Minimum wire rough-in

Even if the customer has not requested individual thermostats, it is recommended that you rough in a minimum of 3 wires to each loop location for future upgrade capability.

2. System Design and Installation

2.1 The mains

PEX tubing mains are recommended to reduce labor and architectural impact. For a slab-on-grade installation, the mains can be buried below or within the slab. For a wet or dry on plywood application, the mains can be installed within the joist cavity. Always allow for the expansion and contraction of the mains, as the temperature fluctuates. It is recommended that the tubing be allowed free movement and is not fastened directly to the floor joists.

2.2 Requirements of a hydronic control system

The intent of a hydronic heating control system is to achieve heating comfort, system protection, energy saving and ease of use.

Heating comfort is achieved by:

- *keeping proper system temperatures, and*
- *directing the right amount of heat when and where you want it.*

System protection is achieved by:

- *protecting the primary heat source (e.g. boiler) from corrosion and thermal shock, and*
- *reducing equipment cycling.*

Energy saving is achieved by:

- *running the system at the lowest water temperature possible,*
- *turning off the system when no heat is demanded, and*
- *minimizing boiler short cycling.*

Ease of use is achieved by:

- *running automatic functions in lieu of manual settings, and*
- *providing easy and consistent wiring and installation procedures.*

3. Control System Strategies

Generally, hydronic heating control systems can be placed into two categories:

- *constant water circulation*
- *intermittent water circulation*

Each of these categories can be further divided into a:

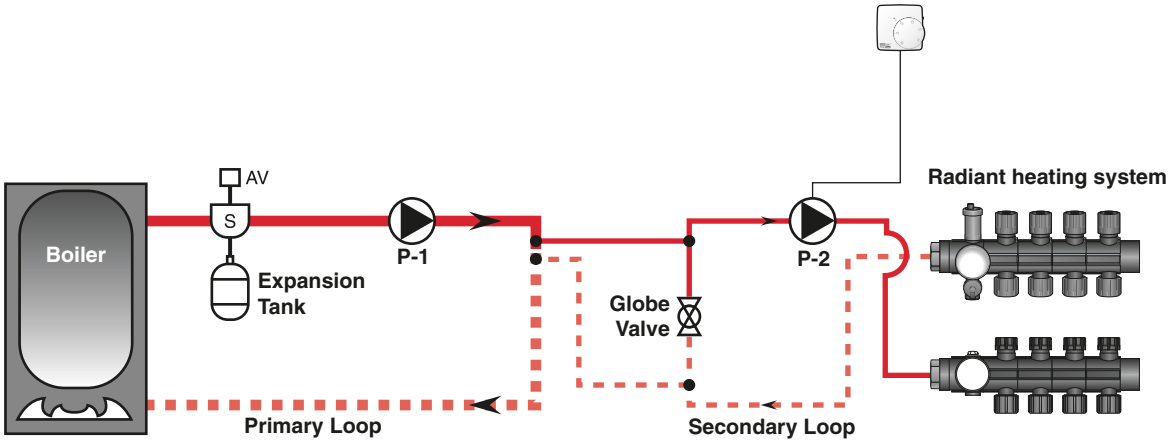
- *system where water temperature is fixed or constant, and*
- *a system where water temperature varies in response to changes in outdoor air temperature and/or indoor air temperature.*

3.1 Using boiler control

The use of an indoor/outdoor boiler control works well with a condensing boiler and single zone heating system. All boilers have aquastats that control output water temperature within a user's set range. The simplest type of control system uses a boiler with controls set to deliver a fixed temperature output every time the thermostat calls for heat. As heat loss increases from the building at colder outdoor temperatures, the boiler will run longer to meet the heat demand.

The water temperature supplied to the floor is preferably kept as low as possible. This minimizes the possibility of overshooting the set indoor temperature when the floor heating system calls for heat.

3.2 Constant water circulation



With a pump running constantly, boiler or zone valves are turned on and off by the thermostat in response to indoor air temperatures.

- *In a single zone heating system, water is circulated constantly through the boiler and the heat is turned on and off.*

- *In a multiple zone environment, water is circulated constantly through the boiler, but is circulated intermittently through each individual zone when a room temperature sensing device (thermostat) turns the zone valve on or off.*

Usually the water temperature in the floor is controlled by a boiler control device, and/or a mixing device. The purpose of a mixing device is to mix return water from the system with the supply water.

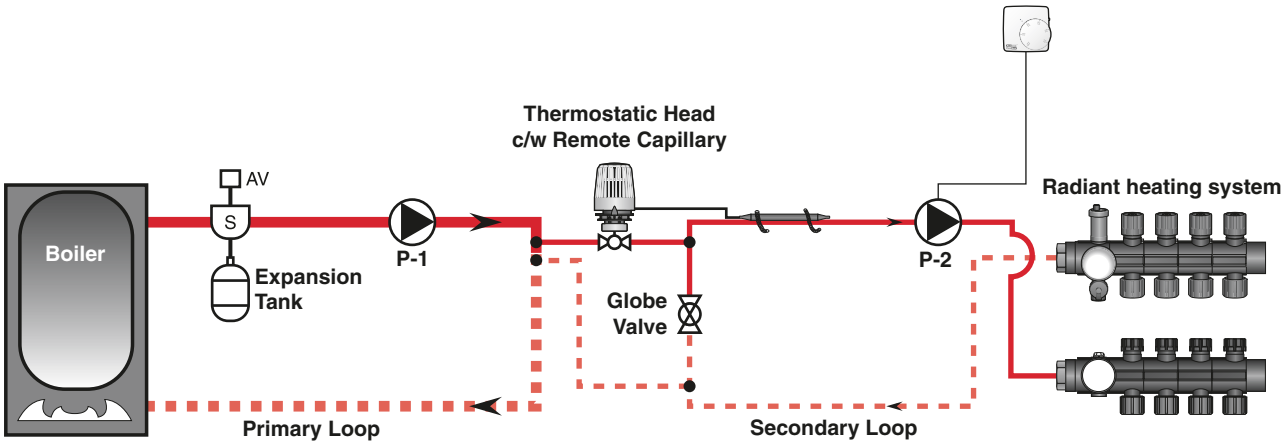
3.3 Varying water temperature

For greater energy saving, the water temperature feeding the floor heating system is allowed to vary in response to the changes in the outdoor/indoor air temperature. It can be done manually or by an indoor/outdoor controller (an automatic device). To avoid a situation of extremely cold water (from a cold system startup) returning to a boiler, the boiler is to be set at a minimum water temperature for protection.

3.4 System controls

For proper system control, a piping layout to allow primary and secondary pumping off the boiler is recommended.

3.5 Set point control



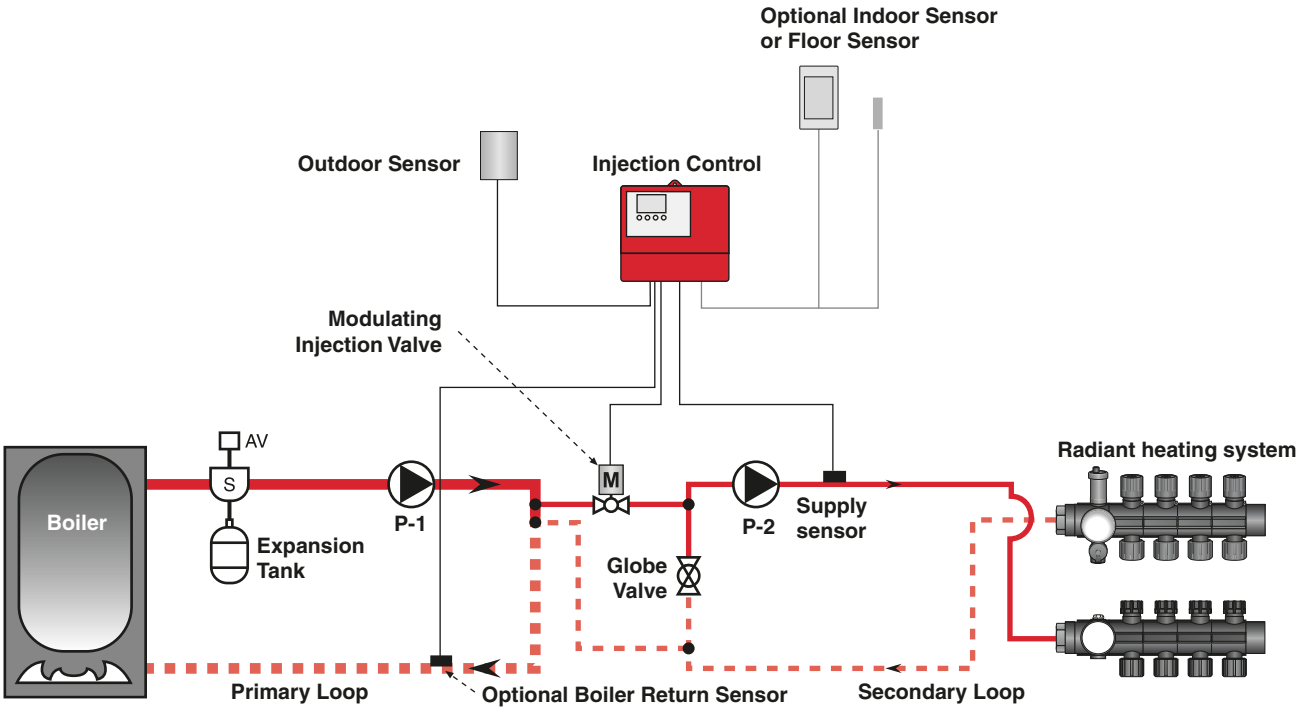
Advantages:

- *simple installation*
- *inexpensive*

Disadvantages:

- *single water temperature set point*
- *must rely on room thermostat to avoid possible overheating*
- *no boiler protection*

3.6 Modulating 2-way injection control



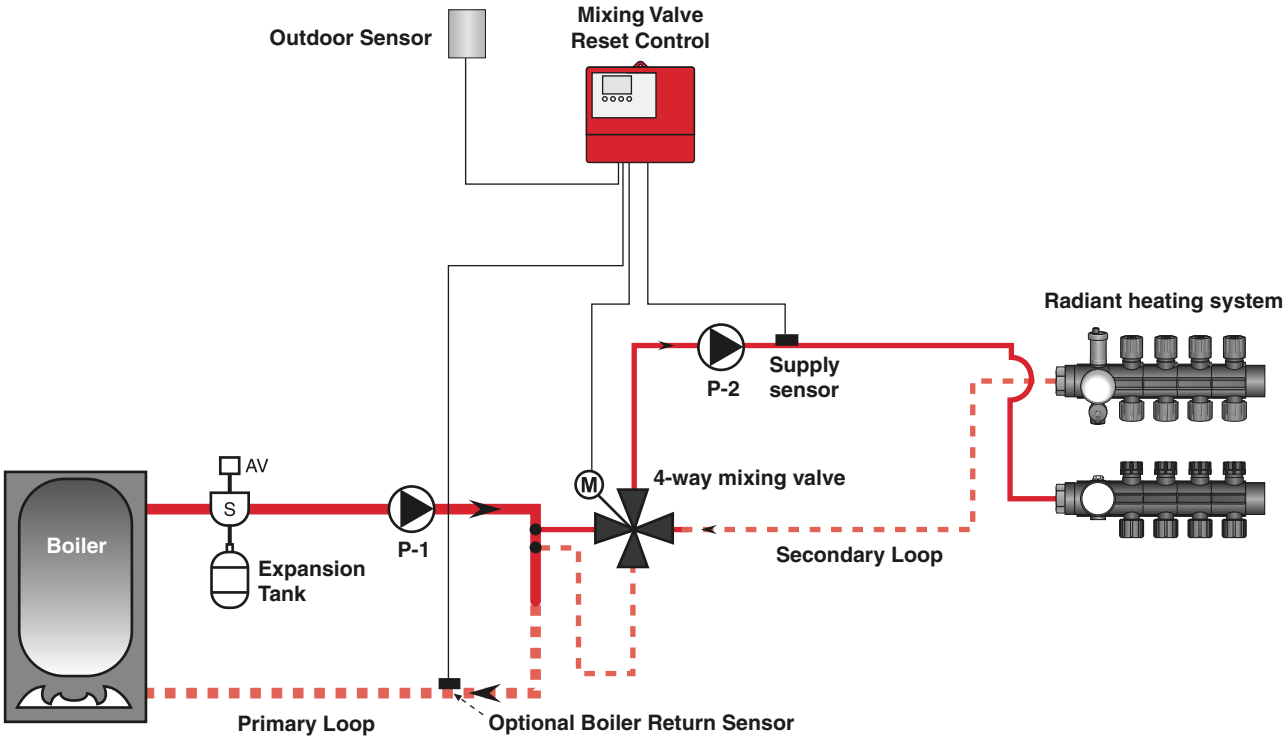
Advantages:

- *water temperature varies automatically in response to outdoor temperature changes*
- *fewer indoor temperature swings*
- *reduced expansion noises*
- *reduced fuel cost*
- *boiler protection*

Disadvantages:

- *relatively expensive first cost compared to set point control*

3.7 Modulating 4-way mixing control



Advantages:

- *water temperature varies automatically in response to outdoor temperature changes*
- *less indoor temperature swings*
- *reduced expansion noises*
- *reduced fuel cost*
- *boiler protection*
- *supports bigger system flow*
- *no flow balancing required*

Disadvantages:

- *relatively expensive first cost compared to set point control*
- *A 4-way valve is a little more involved to install than a 2-way valve*

For some low mass boilers, or situations where higher boiler water temperatures are needed, 4-way mixing is a better system to consider. The 4-way valves have four ports that interface the floor heating loop with the boiler loop. A control disc rotates about a shaft, diverting more or less hot water, as required, from the boiler to the floor heating supply. In the above example, the return water from the floor heating (secondary loop) system entering the right side port, is simultaneously mixed with a portion of boiler water, and is then circulated back to the floor through the top port. The remaining portion of water is returned back to the boiler to be reheated through the bottom port. This can be set up as either a manual set point where the mixed temperature is set to a fixed volume/temperature of water, or in conjunction with mixing value reset control *(see 12.8)*.

3.8 Outdoor reset controls

Monitoring the outside air temperatures, and adjusting the water temperature feeding the floor heating system in response to changes in the outside air temperature, come about through the use of an outdoor reset control, such as the HeatLink® #31355. They regulate water temperature by controlling the mixing devices. In most cases, the water temperature in the radiant heating slab is raised by one degree for every two to three degree drop in the outside air temperature.

3.9 Intermittent water circulation

The above reset control works well for large common areas. However, for multiple zone installations, water temperature is usually set for the zone in the project that is the most difficult to heat. Here zone valves are used to interrupt heat circulation to the room that is the easiest to heat, to avoid overheating.

3.10 Zoning

Zoning refers to dividing the system application into different areas of thermostatic control.

- *Zone control uses input information from zone thermostats to direct heat to where it is necessary.*
- *A separate thermostat works in conjunction with a zone valve that opens and closes upon heating demand to allow hot water to flow through a piping circuit.*

Zone control can be easily and conveniently facilitated and integrated with StatLink® controls #40226 and #46000 series thermostats.

3.11 Control system selection guide

An appropriate control strategy should take into account: the cost, simplicity of installation, and ease of operation. The following chart is provided as a helpful guide.

Basement	Main Floor	Upper Floor	Suggested Control System	Multiple Zones
Full (Wet)			Set Point (#57094) + Thermostats	StatLink® #40226, #46000 series thermostats
Full (Wet)	Partial (Wet or Dry)		Set Point (#57094) + Thermostats, or 2 separate Set Point Controls (one for wet & one for dry).	StatLink® #40226, #46000 series thermostats
Full (Wet)	Full (Wet or Dry)		Injection (#31355) +Thermostats Reset (heat) curve set for Dry floor requiring higher water temperature.	StatLink® #40226, #46000 series thermostats
Full (Wet)	Full (Wet or Dry)	Full (Wet or Dry)	Injection (#31355) + Thermostats, or 4 Way Mixing (#31355) + Thermostats Reset (heat) curve set for Dry floor requiring higher water temperature; or, 2 separate controls (one for all wet and dry).	StatLink® #40226, #46000 series thermostats