

Heat Pump Helper

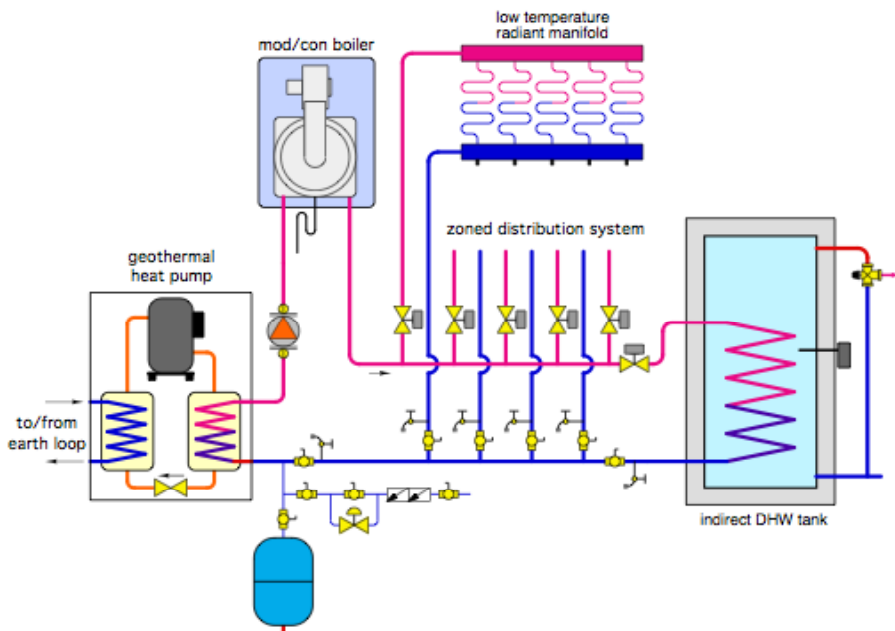
The Glitch

Overview: Given the rapid increase in the price of propane, an installer decides to install a geothermal heat pump system to supply several zones of radiant floor heating.

He's heard that geothermal heat pumps work well with low temperature distribution systems, but that the heat pump should be sized for the building's cooling load rather than the heating load so it will provide good dehumidification in summer.

To supplement the geothermal heat pump in heating mode, he plans to install a new mod/con boiler. The boiler will only fire when the heat pump cannot maintain the necessary supply temperature to the load. The system he designs is shown below.

Exercise: Can you spot at least 4 incorrect design details?



The Fix

A geothermal heat pump and boiler can be used together in the system. The original plan does allow the possibility of the modulating boiler adding heat to the flow leaving the heat pump. However, a typical geothermal heat pump and low mass mod/con boiler can both generate substantial flow resistance, which would add together if they were connected in series as shown. This could severely bottleneck flow to the point of causing operational problems with both the heat pump and boiler.

Furthermore, there's no way to bypass flow around either the boiler or heat pump when either is inactive. Thus, if either heat source is inactive while the other is operating, the inactive heat source becomes a heat dissipater. Thus the series piping arrangement is not recommended.

The original design will likely subject the heat pump to short cycling when only one or two zones are active. A buffer tank has been added to the fix drawing to stabilize operation of the heat pump. In this case, the heat pump operates to maintain the buffer tank within a set temperature range. The buffer tank then becomes the heat source to the system when its circulator is turned on.

In the fix drawing, the two heat sources (boiler and buffer tank) are piped in parallel. They can operate independently, each with their own circulator, or they could operate simultaneously in low temperature space heating mode.

A typical geothermal heat pump is limited to a supply water temperature of about 120 °F. Although this may be fine for low temperature radiant heating, it will not be high enough for domestic water heating via an indirect water heater. Thus the boiler will handle the DHW load. In the fix drawing, this is enabled by a separate circulator. Upon a call for domestic water heating, the boiler goes to an elevated setpoint temperature, the DHW circulator turns on, and the boiler's space heating circulator turns off. If necessary, the heat pump could supply space heating during this mode.

Another problem with the original design is that there is no means of differential pressure control in the original schematic. This has been addressed in the fix through use of a variable speed pressure-regulated circulator.

Finally, the original design has no central air separator. It also shows an unvented high point in the piping leading into the heat exchanger of the indirect tank.

