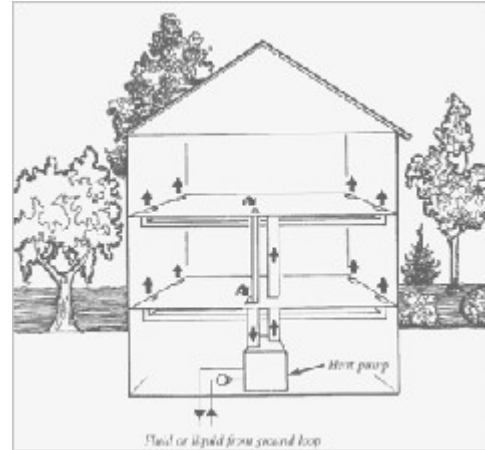


Section Two – Water-to-Water Specifics

*In-floor hydronic system is only one example of
a water-to-water installation*



Source: Residential Earth Energy Systems - A Buyer's Guide, ISBN: 0-662-30980-4, Cat. No.: M92-236/2001E, Natural Resources Canada, 2001. Reproduced with the permission of the Minister of Public Works and Government Services Canada, courtesy of Natural Resources Canada [2007].

Questions

What considerations need to be addressed with a water-to-water system?

What does a water-to-water heat pump hook-up look like?

Where can you use a hot-side/cold-side application?

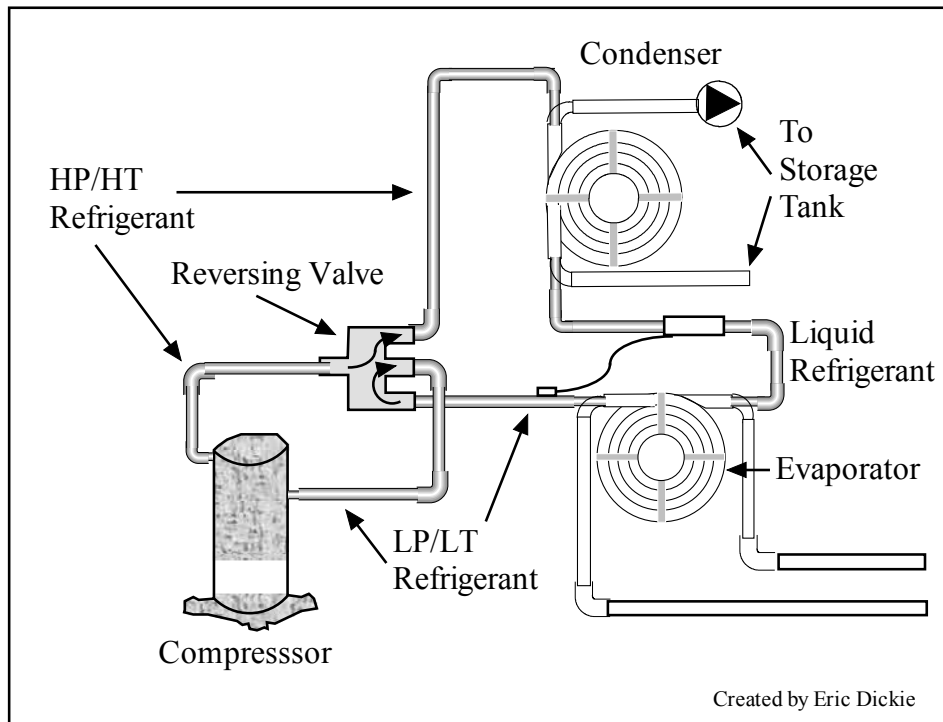
Details

Although most of the concepts covered so far apply to both water-to-air and water-to-water, there are specifics on water-to-water heat pumps that need pointing out.

In water-to-air heat pumps, heat is initially transferred between the ground and the “water”, or more correctly, the loop fluid in the ground exchanger. There is a second heat exchanger where the heat is transferred between the loop fluid and the refrigerant, and then there is a final heat exchanger where the heat is transferred between the refrigerant and air, as a fan blows the air over a heat exchanger coil. Two things to realize, however:

- We have the additional option of exchanging the heat with water rather than air in that final stage.
- Using a water-to-water heat exchanger opens up a tremendous number of creative possibilities for us, and can create efficiencies that are substantially higher than even a water-to-air heat pump.

Ground Source Water-to-Water System in Heating Mode



LP/LT = Low Pressure, Low Temperature
HP/HT = High Pressure, High Temperature

Figure 35: Ground Source Water-to-Water System in Heating Mode

The operating principle is exactly the same; the refrigeration circuit still works exactly as it does with the water-to-air one – the only difference is that instead of a refrigerant-to-air heat exchanger as the “final” step in the process, the heat exchanger is an additional refrigerant-to-water one (additional in that this is what the exchanger that operates between the refrigerant and the ground loop fluid is). As “water” is pumped through on the load side, it is continually exposed to “new” refrigerant, and heat is transferred to or from it, depending whether there is a call for heated water or cooled.

The water-to-water, or liquid-to-liquid heat pump is, then, relatively straightforward in its operation. Because there are a variety of things that can be done with the heated or cooled water, the distribution side of it takes on more complexity. We will look at details of this a little more closely when we get into the water-to-water distribution section, but it does make sense to familiarize ourselves with the general operating possibilities now. First, let us look at a diagram of a typical water-to-water set-up shown specifically for heating:

Single Water to Water Heat Pump Hookup

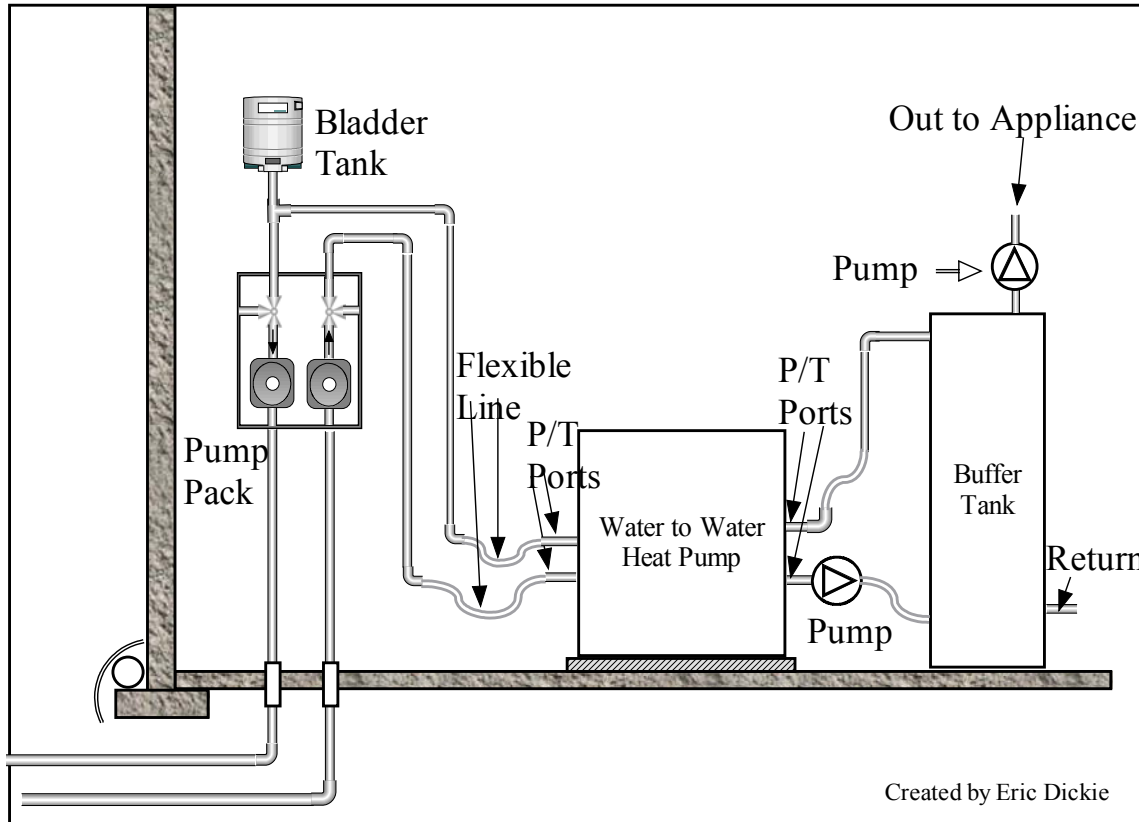


Figure 36: Water-to-Water Heat Pump Hook-up

Why is it so important to review a diagram of the water-to-water system? Primarily, it introduces the buffer tank. This is an extremely important component in the package, in that it creates a reservoir of heat that we can draw from.

Remember that we mentioned the concern about short cycling with respect to the water-to-air heat pumps. The same concern holds with the water-to-water ones. It would be a huge mistake (though it is a mistake that's been made!) to run the heat pump line directly to what you wanted to heat, say perhaps the hydronic heating lines in a floor. What would happen there is that the system would turn on every time there was a call for heat at any point in the building, and short cycling would almost certainly be the result. In addition, though somewhat related, the fewer the number of times the heat pump can start up, the more efficient it will be.

One more reason for the storage tank is that if the flow went straight from the heat pump to the distribution system, and if only a small portion of the distribution system called for heat, flow could be reduced to the point where it would be insufficient for the heat pump.

In this diagram, the heat pump's only visible job is to keep the water in the buffer tank hot. A thermostatic control will trigger the heat pump whenever the temperature of the water falls below a set temperature (in

heating). As may be obvious, the larger the buffer tank, the greater the reservoir of heat we have, and the fewer the number of times the heat pump will have to cycle.

From this above diagram, we can run the hot water to anywhere that we can use it to distribute heat. We'll look at this more closely when we get to distribution systems, but a couple of the more basic applications are:

1. Fan coils – the heated water is directed to a water-to-air heat exchanger, where the water moves through the coil, and a fan blows air over the coil. What advantage might this have over a water-to-air unit? One main reason is that it allows you to place fan coils wherever in the building heat may be required, and instead of having to run ducting to those areas, you can simply run piping.
2. In-floor heating – Pipes can be run through concrete in the floor, and the heated water passed through the pipes. Ahhh, if your feet are warm, you are warmer, and it can cut the amount of heat that needs to be deposited into the building by 20%. Remember that this can mean reducing the size of the heat pump, and even more important, that of the field. The savings on the energy exchange system can be put toward the distribution system.
3. Unique applications – anywhere where you may need “spot” heat, you could run a hot water line to that point, and typically design something that would fill the need. Examples will come later, but let your mind run free on this one.

The diagram, and the preceding discussion, is basically meant to describe a heating system, but what would happen if we triggered the reversing valve on the heat pump. In the water-to-air application, this rejected heat to the ground, and supplied us with cool air. In the water-to-water system, as you've no doubt already figured out, it will supply us with cool water. What can we do with the cool water?

1. Run it through fan coils and provide cooling in rooms or space.
2. Yes, we can run it through the floor to provide some cooling, but we have to be extremely careful with this. If we cool the floor too much, water will condense out of the air, and create moisture on the floor. This is not good for carpets or wood, though it can be good for mould growth. Don't jump into this without doing some pretty serious research.
3. Unique applications once again – industrial process cooling, refrigeration, and many other applications. Let your imagination lead to innovative ideas!

Note as well: We can apply what is called an outdoor reset to the buffer tank temperature. As the outdoor temperature warms up, there is less heat required to maintain the temperature of the building. What this enables us to do is to lower the demanded tank temperature. The heat pump thus operates at a lower output temperature, and when that happens, the efficiency of the heat pump climbs quite significantly.

Could we complicate the diagram a little bit, and add a specific cold tank? Yes, we could. We'd have to decide which is our default setting, heating or cooling, but once that default condition was satisfied, a signal would switch the heat pump from heating to cooling or vice versa, and trigger three-way valves which would deflect the water in the appropriate direction. We can have both heating and cooling.

The control work gets a little bit challenging, but something else that is very “doable” is to heat and cool simultaneously. We have mentioned this back in the introduction, but here is where we at least start to get more specific about how it can be done. Suppose we wanted to heat a pool and cool a building at the same time. Rather than even bringing the ground loop into play, could we pull heat from the interior space, and