



## **Buffer & DHW Tank Elevation with Chiltrix Air-to-Water Heat Pumps (Heat Pump on Roof, Tank in Basement, Atmospheric Tank, etc.)**

When buffer tanks or domestic hot water (DHW) tanks are located much lower than the outdoor heat pump (common in basements, typically 8–15+ ft lower), or when the heat pump is on a roof, or when using an “open” loop with an atmospheric tanks (non-pressurized), a few extra installation steps help everything run smoothly and efficiently.

### **Why Elevation Matters:**

In a closed hydronic loop, the total static head nets to zero because the rise on the supply side is balanced by the drop on the return side. However, significant elevation differences create practical effects on:

- Pump performance
- Air management
- Unwanted flow when the pump is off
- System filling and pressure control

**With an atmospheric pressure tank (open or non-pressure tank) there is no closed-loop gravity counterbalance, so any static lift must be accounted for.** Following a few simple best practices avoids common issues and makes the system easier to install, commission, and maintain.

### **Pump Location (Recommended Practice)**

For best results when tanks are substantially lower than the heat pump (more than ~6–8 ft), you can consider relocating the circulator pump to the mechanical room near the tanks, on the return line heading back to the heat pump. When using an atmospheric tank, it is very important to do this, and to locate the pump near the bottom of the tank so that it pumps “up” and does not need to perform any lift on the suction inlet.

Chiltrix units ship with a variable-speed pump in a separate box and a factory-installed spacer. Leave the spacer in place to bypass the internal pump location, then mount the pump externally at the low point.

Benefits of relocating the pump:

- Places the pump inlet at the lowest point in the system for optimal performance.
- Makes initial system charging and air purging much easier (fill/purge from the lowest point).
- Improves long-term service access — the pump can be isolated and removed without draining the entire loop.

**Always refer to the Chiltrix installation manual and glycol guidelines.**



- Helps maintain good flow and efficiency with lower pump speeds (quieter and longer lasting).
- Allows the use of an atmospheric tank.

Use full-port ball valves and unions (or stainless flex hoses) on both sides of the pump for easy isolation.

### Thermosiphoning and Check Valves

For a system that is always-on, this may be less of an issue; however, it must be addressed, particularly because of the way customers may use timers, smart thermostats, load shifting strategies, and the like. Significant elevation differences combined with temperature gradients create buoyancy-driven flow (thermosiphoning). Hotter, less-dense fluid rises while cooler, denser fluid sinks. The driving head can be approximated as:

$$\Delta\rho \cdot \Delta T \cdot \beta \cdot g \cdot H$$

where  $\beta \approx 0.0002/^\circ\text{F}$  for water, and  $H$  is the vertical distance between the heat source/sink centroids. For a 20 °F temperature difference and 15 ft elevation, this can exceed 0.06 ft of head — enough to drive several GPM of reverse or bypass flow when the main pump is off.

**Practical installation notes for the field:** Uncontrolled thermosiphoning when the system is off wastes heat to the mechanical room or allows reverse flow through to the outdoor heat pump, wasting the heat outdoors. Install full-port, low-cracking-pressure spring-check valves (high-  $C_v \geq 20\text{--}30$  at design flow) on both the supply and return lines, oriented to allow pump-driven flow only. Face the arrows in the direction of flow. Gravity-type checks are acceptable if mounted vertically, but spring-loaded valves are preferred for reliable seating regardless of orientation. Place checks as close as practical to the heat pump ports to minimize the thermosiphon loop volume. In multi-unit parallel installations, check valves on each unit's supply and return prevent cross-flow between units. Even modest thermosiphon can cool a buffer tank (or DHW tank) 5–10 °F overnight, dropping the heat pump's COP average.

**Note:** When the pump is off, buoyancy tries to drive flow around the loop. Although one direction may appear “allowed” by both check valves, the light springs still provide enough resistance (cracking pressure + friction) that the very weak natural buoyancy force usually cannot initiate meaningful circulation. In practice, this arrangement reduces thermosiphon to negligible levels. In certain applications and piping configurations, more may be needed. If so, install an actuated zone valve (normally closed) on the return line (the pipe going up from the tank to the heat pump) that is only open when the pump is on.

### Air Purging and System Charging Benefits

With tanks lower than the heat pump, the outdoor unit and its piping become the high points in the system. This makes air removal easier if you follow the right procedure:

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- Fill and purge from the lowest point (near the relocated pump and tanks).
- Install automatic air vents (high-Cv float-type) at all local high points, especially near the heat pump.
- Add a high-Cv coalescing micro-bubble air separator on the supply line leaving the heat pump.

#### **Additional benefits:**

- Much easier initial fill and air elimination — use a separate high-head transfer pump (not the system circulator) for powerful flushing.
- Glycol mixes (which make bubbles rise slower) are easier to handle with this layout.
- Ongoing maintenance is simpler — vents with shut-off valves allow bleeding without draining the system.
- Better overall de-aeration leads to quieter operation, higher efficiency, and fewer flow issues over time.

#### **Pressure, Expansion Tank, and Other Tips**

Elevation creates hydrostatic pressure differences (roughly 0.433 psi per foot of height for water). Locate the expansion tank (diaphragm or bladder type) on the pump suction side at the lowest point. This helps stabilize pressure, reduces swings, and supports good system performance.

- Pre-charge the tank 2–3 psi below the cold static fill pressure.
- Use a Y-strainer on the return line to protect the heat pump's heat exchanger.
- Add gauge ports at the heat pump and tank for easy verification.
- Select all components with high Cv ratings (full-port valves, low-loss strainers, etc.) to keep total head low.
- If using an atmospheric tank, locate the tank low near the base of the tank to eliminate any needed suction lift of potential loss of prime.

#### **Quick Checklist**

- Optionally relocate pump to return line near tanks (when elevation > ~6–8 ft) or when using an atmospheric tank and leave factory spacer in place.
- Relocation of pump is not-optional for atmospheric tanks.
- Install high-Cv spring check valves near heat pump ports.
- Fill/purge from the low point with a transfer pump; add high-point vents and a coalescing separator.
- Place expansion tank on suction side; follow proper pre-charge procedure.
- Use full-port ball valves and unions (or stainless flex hoses) on both sides of the relocated pump so it can be isolated and removed without draining the supply loop.
- Verify flow and  $\Delta T$  after commissioning.

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