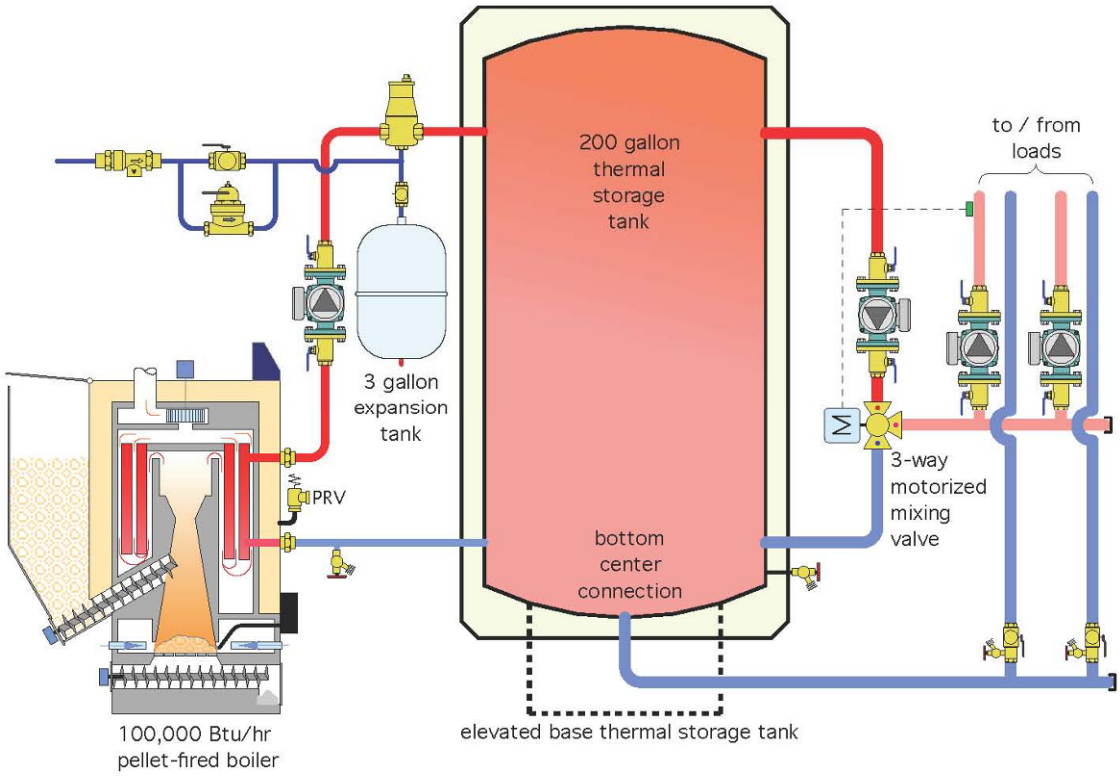
The Glitch & The Fix, April 2015

Pellets, piping and puddles

The Glitch

An installer is asked to use a pellet-fired boiler to supply heat to two zones of low-temperature radiant floor panels. He installs the system shown below. It includes a three-way motorized mixing valve to reduce the supply water temperature to the distribution circuits. He carefully sizes the thermal storage tank to 2 gal. of water per 1,000 Btu/hr. of boiler rating and buys a tank with a center bottom connection as shown.

Look over this system and identify at least six errors, omissions or unnecessary hardware.

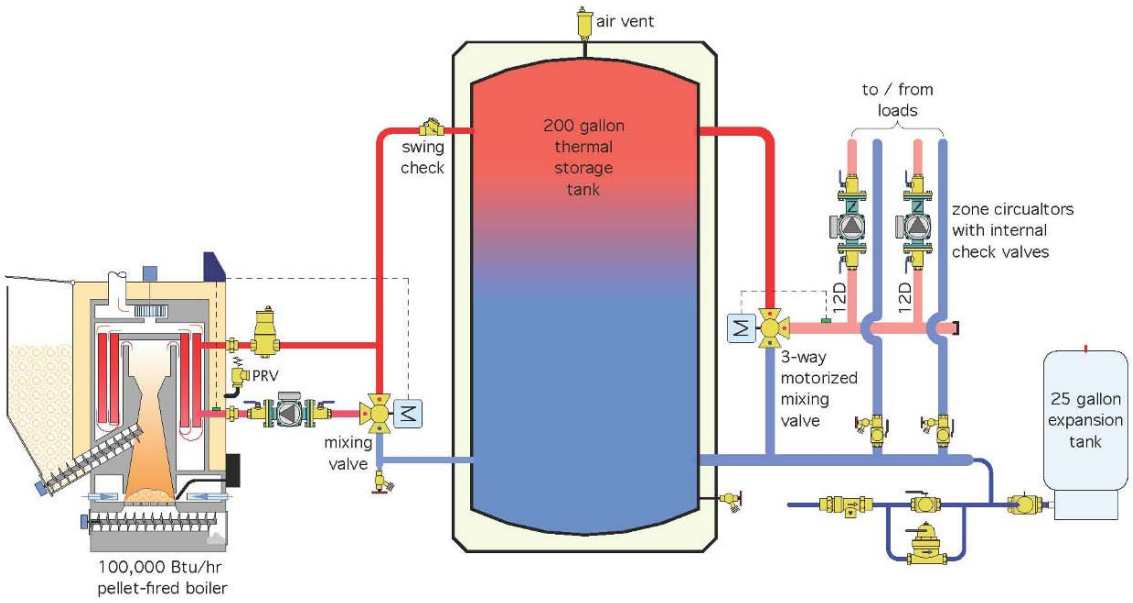


The Fix

Nearly all pellet-fired boiler use steel fire-tube heat exchangers. As such, they are conventional boilers from the standpoint of needing protection against sustained flue gas condensation. The system shown in the Glitch drawing cannot limit heat transfer between the boiler and the thermal storage tank. Thus, when the water temperature entering the boiler is below approximately 130° F, which may be a high percentage of the boiler's operating time, flue gases will condense within the boiler.

Eventually, this condensation will probably leak out and form puddles on the floor, hence this month's title. However, that's not the worst of it. If the sustained flue gas condensing is allowed to persist, it will eventually scale and corrode the boiler's heat exchanger, as well as its vent connector piping and chimney.

The Fix drawing shows one way to prevent sustained flue gas condensation through use of a three-way motorized mixing valve that reacts to the boiler's inlet water temperature. This valve, which is controlled by the boiler's electronics, limits heat transfer from the boiler to the tank when necessary to avoid *sustained* condensing mode operation.



Other errors in the Glitch drawing that have been corrected in the Fix drawing include:

1. A vertical flow jet would be created inside the thermal storage tank due to the bottom center connection. This would mix the water in the tank and destroy temperature

stratification (e.g., hottest water at top of tank, coolest water at bottom). Without internal detailing that could prevent vertical flow jets from the bottom center connection, the alternative of connecting to the lower side of the tank is preferred.

2. There's an extra circulator between the upper right outlet of the tank and the hot water port of the three-way mixing valve for the distribution system. It's not needed. If present, the "helper circulator" would be in a quasi-series configuration with the two zone circulators. This would induce flow through a zone circuit that is supposed to be off when the other zone circuit is on.

3. The two zone circulators are mounted too close to the supply header. Always allow at least 12 pipe diameters of straight pipe upstream of the inlet of any circulator. This allows turbulence to partially dissipate before the flow stream enters the circulator. The result is a quieter circulator.

4. The zone circulators are shown without internal (or external) spring-loaded check valves. Without these valves, there will be flow reversal through an inactive zone circuit if the other zone circuit is operating.

5. The 3-gal. expansion tank hanging from the underside of the air separator is grossly undersized given the volume and potential temperature cycling range of the thermal storage tank. It's also poorly positioned relative to the boiler circulator (e.g., that circulator is pumping toward the expansion tank rather than pumping away from it). Use proper sizing calculations for the expansion tank

6. The purging valves on the return side of the zone circuits are upside down.

7. The supply water temperature sensor for the three-way mixing valve is only sensing the temperature on one zone circuit. It needs to be moved to the header upstream of both zone takeoffs.

8. There is no air vent at the top of the thermal storage tank. Without it, air will be trapped above the upper piping connections.

9. There is no check valve to stop reverse thermosiphoning from the thermal storage tank through the boiler when the boiler circulator is off and the boiler cools down. Reverse thermosiphoning would continually dissipate heat from the thermal storage tank under such conditions.