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Condensate Pumps 101: Mechanics, Problems & Solutions

Understanding the operation of a condensate pump is pretty straightforward. The condensate pump is made up of a pump and motor with an impeller on the end of it, a receiver that the pump and motor is mounted on (usually cast iron but steel can also be used). Cast iron receivers are more rugged and last longer in these corrosive environments. Condensate usually has a low pH (which means it is on the acidic side).

Inside the receiver is a float assembly (not unlike a ballcock found in a toilet) that is connected to a float-operated electrical switch, which is attached to the receiver. The receiver has an inlet opening near the top side of the receiver; it also has an opening on the top where a vent pipe is connected. The condensate return piping from the system is connected to the inlet connection of the receiver.

The vent pipe is used to vent the air from the system. As condensate and air travel along the return piping, it enters into the receiver through the inlet connection. The condensate then falls to the bottom of the receiver while the air enters into the receiver and exits out through the vent pipe located at the top of the receiver.

In effect, the vent pipe of the condensate pump is the *main air vent* for the system. Make sure that there are no water pockets in the return piping because that could prevent air from getting out of the system. Also *never* plug the vent line because condensate pumps are not rated for pressure. If they become "pressurized" because of a blocked vent line, they could explode!

As the condensate continues to gather in the receiver, the float part of the assembly starts to "float" up or rise up with the rising level of condensate. At some point, the float-operated electrical switch "makes," closing a set of contacts that turn the pump on. The condensate pump discharges the condensate to either the boiler directly or maybe to a boiler feed tank in the boiler room.

Naturally, as the pump discharges the condensate from the receiver, the water level and the float in the receiver lowers to a point where the switch "breaks," opening the contacts that turn the condensate pump off. That is basically what a condensate pump does—as returning condensate enters the receiver, it raises the float, which eventually turns the pump on. As the water level drops in the receiver, so does the float, eventually turning the pump off.

The Devil is in the Details

There are a couple of details that you need to pay attention to when piping a condensate pump into the system. On the inlet side of the receiver, it is good piping practice to install some type of strainer (Y strainer or basket strainer are two popular choices) just before the condensate enters into the receiver. There is sediment in old steam systems that the condensate will pick up as it is flowing back to the receiver. If the sediment makes its way onto the face of the pump's seal, it will groove lines into the carbon and ceramic seal causing it to leak. If the leak isn't discovered quickly, the condensate will work its way into the bearings of the motor, causing it to eventually fail.

On the discharge side of the pump, there should be a check valve, a balancing valve and a service valve. The purpose of the service valve is that if you need to work on the pump, you can close the service valve and isolate the pump from the system. The check valve is needed so whenever the pump is off, the water that is in the piping on the discharge side of the pump doesn't fall back into the receiver. If the check wasn't there, or if sediment gets underneath the flapper of the check, the water would flow back into the receiver, causing the float to rise and bring the pump on. The pump would then unload the receiver and shut off. This cycle would "seesaw" back and forth endlessly.

If you happen to walk into a boiler room in the summertime and the steam boiler is off because it is used for heating, but the condensate pump turns on and off

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from seating properly on its seat. The balancing valve is used to provide a certain amount of "back pressure" on the pump.

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Standard stocked condensate pumps are rated to pump the condensate at a discharge pressure of 20 psig. But in most applications the boilers are running at very low pressure, typically 2–5 psig. When the pump turns on and it doesn't "see" 20 psig of pressure, it will run way out on its curve, pumping too much condensate too quickly. It can cause the check valve to chatter, creating unnecessary noise. By closing the balancing valve, you are creating the additional pressure the pump was designed to work against, thus slowing the flow rate down to where it can operate properly and quietly.

Condensate Temperature

I get calls every now and then complaining about the condensate pump turning on, but not pumping water out of the receiver. In some cases, the water starts pouring out of the vent pipe. Usually the problem is related to the temperature of the condensate. I am not referring to temperature that exceeds the material of construction or the pump's seal rating (most are rated at 250°F). What I am referring to is when steam is allowed to enter into the return lines (usually bad traps that have failed in the open position) and elevate the returning condensate's temperature above 185–190°F.

When the condensate becomes too hot and gets close to its boiling point, there isn't enough pressure on the water to remain a liquid. When the pump turns on and the water enters into the eye of the impeller, it experiences a drop in pressure. Because the water is so close to its vapor pressure (boiling point), it flashes into vapor/steam. Of course, the impeller isn't capable of pumping steam, so the impeller is spinning at 3,600 rpms and no water is discharging out of the receiver.

This isn't because of a bad pump, the water is simply too hot. There isn't enough pressure on the water to keep it in its liquid state.

Remember, this is an open system and the only available pressure is the height of the condensate that is sitting in the receiver, which is less than a foot. In a closed hot water heating system, you have a fill valve and an expansion tank that provides a lot of pressure so the pumps have no problem circulating the 200°F water.

The answer to this problem is to lower the temperature of the condensate. Fix the radiator traps that are leaking and make sure the pressuretrol isn't set too high. There is a relationship between the pressure of the steam and its corresponding temperature that holds true to the temperature of the condensate. This is another reason why there is no benefit to cranking up the pressuretrol setting in a heating application. **ICM**

If you have any questions or comments, e-mail me at *gcarey@fiainc.com*; call me at FIA 1-800-423-7187 or follow me on Twitter at *@Ask_Gcarey*.