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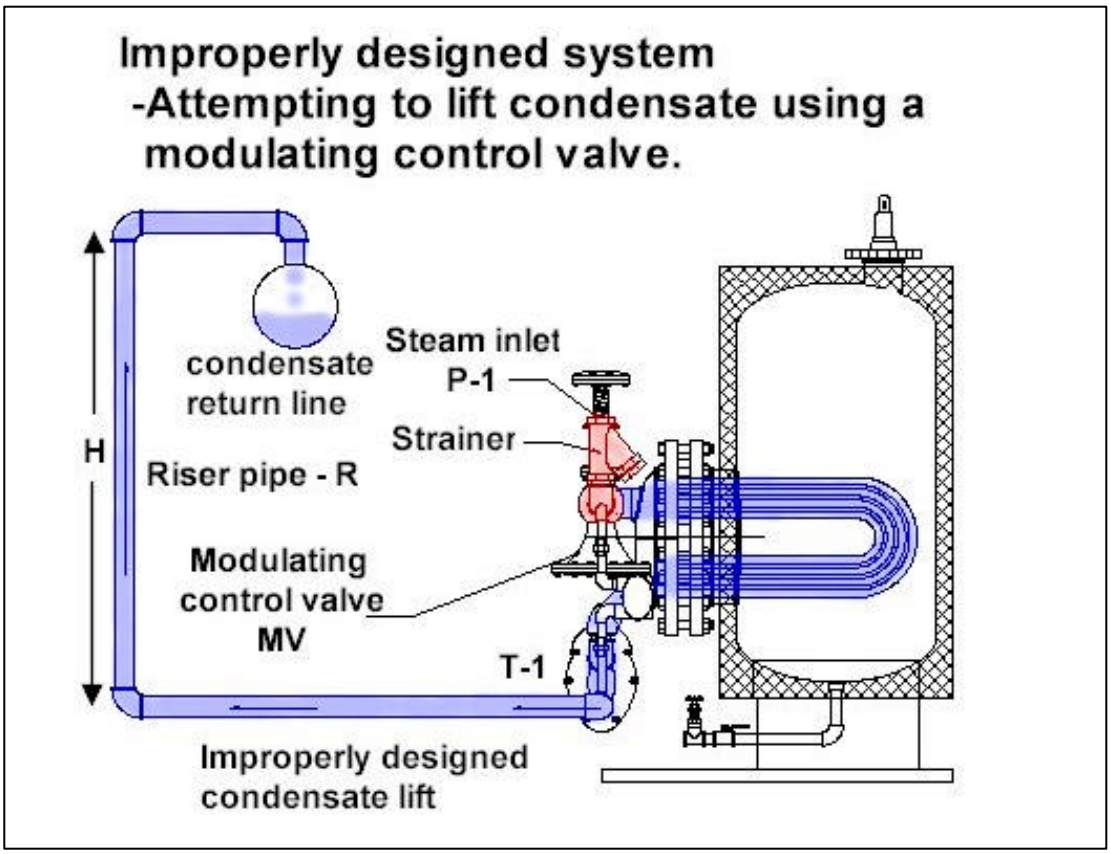
TECHNICAL PAPER: Improper condensate lifting with steam when using a modulating control valve.

Cemline often runs into the problem of customers attempting to raise the condensate in the return line above the outlet of the trap. This can cause problems with the heater or steam generator. This white paper is being written to attempt to clear up many widely held misconceptions about condensate lifting and what really happens. Look at the drawing below.

A heater or steam generator vessel is being fed steam. The steam is controlled by a modulating control valve which opens when there is a call for heat or closes when the vessel is satisfied. The condensate is piped into a trap, typically float and thermostatic, and the discharge of the trap is piped into a riser pipe, designated (R). The riser pipe has a vertical height of (H) and then goes in a horizontal direction to the condensate collection system from whence it is returned to the boiler.

Condensate is water and water can be raised approximately 2.2 feet for each pound of pressure applied to the bottom of a column of water. There are losses due to piping friction and to account for this we will limit the lift to 2 feet per pound of pressure in this discussion. **Keep in mind that all of the piping beyond the outlet of the trap is filled with condensate**. It is widely believed that the column of water is lifted with



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steam and that the riser pipe is filled with steam. Not true, the riser pipe is always filled with condensate. When the trap opens to discharge condensate any steam pressure behind the trap provides the motive power to push the column of water up. Since the trap is designed to let condensate out and keep steam in only condensate will be discharged from the trap and into the riser pipe (R).

Let us make a theoretical example. Looking at the drawing if the steam inlet pressure is at 15 psig pressure (P-1) going into a modulating control valve (MV). The steam goes though a submerged coil and any condensate formed is discharged through trap (T-1). At 15 psig steam prior to the control valve (P-1) and the height of the riser pipe is 6 feet, as long as the pressure in the tubes of the submerged coil is greater than 3 psig there is enough pressure to discharge all of the condensate formed from the coil. As the vessel's pressure or temperature is satisfied the valve (MV) will begin to modulate closed. When the valve (MV) closes the pressure in the coil will begin to drop and eventually will become 0 psi. As soon as the pressure in the coil head becomes less than 3 psi there is no longer enough motive power to raise the column of condensate in the riser pipe (R) and any further condensing steam will accumulate in the coil head and in the tubes of the coil. If there is no check valve in the riser line the condensate in the riser pipe will back feed into the coil until the level of condensate in the coil and condensate in the riser are equal. Even with a check valve in the riser line when the steam pressure is modulated below the pressure required to support the column of condensate will remain in the submerged coil.

Several things can happen when the coil is flooded either fully or partially with condensate.

1. Water hammer as a result of condensate flashing when the control valve opens again and steam is introduced into the steam coil.

2. Corrosion from the inside of the tubes of the coil due to the aggressive nature of some condensate.

3. Erratic temperature or pressure control due to heat being transferred from hot condensate into the fluid in the vessel.

It is recommended to pipe the condensate from the main trap to a gravity drain. If lifting of condensate is required the designer/installer should make provisions to provide a condensate pump to lift the condensate.

For further information regarding proper condensate piping practices, please refer to the 2004 ASHRAE Handbook, HVAC Systems and Equipment, Chapter 10 - Steam Systems.