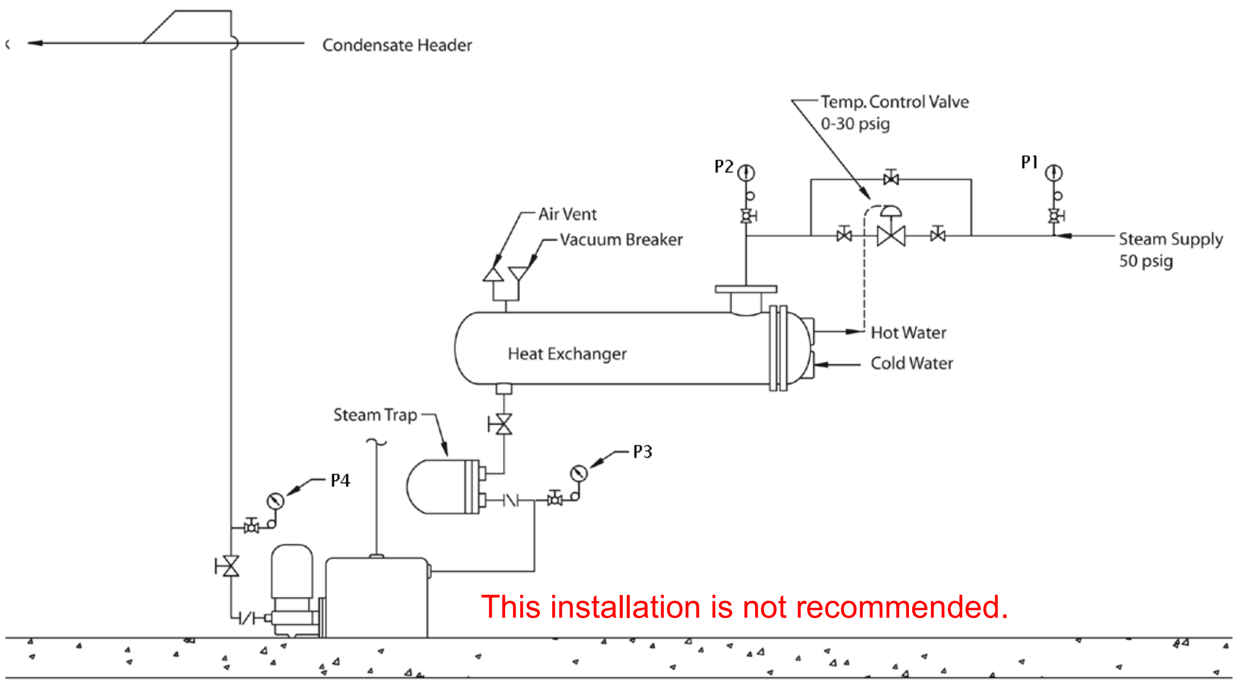
Tech Sheet #SPD 207

Importance of Flash Vessels for Supplying Condensate to Electric & Non-Electric Condensate Pumps

The diagram below depicts a type of installation that exists where the steam trap discharges directly into a floor-mounted condensate receiver/pump. While this is a common type of installation, users often experience significant pump maintenance and reliability issues, including cavitation and damaged pump seals or impellers, resulting in overflow of condensate onto the floor.

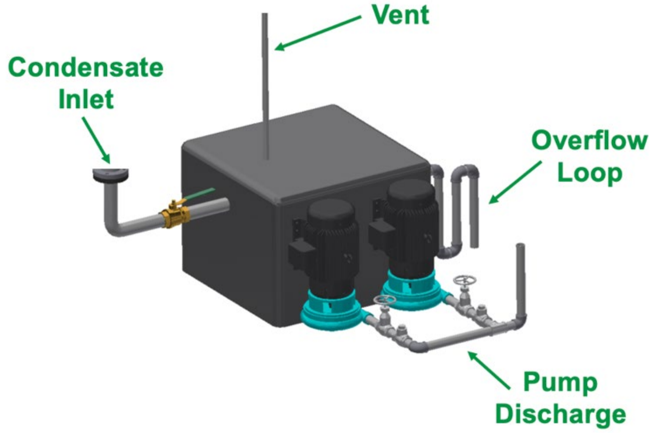


Although such poor reliability may be considered normal, the cause of premature pump failure can often be traced to improper handling – or more specifically – improper **flashing** of high temperature condensate. The designers may have misunderstood or otherwise misused the floor-mounted receiver vent as a flash vent.

A main purpose of the receiver vent is to equalize the receiver's internal pressure with atmosphere, allowing condensate to enter the receiver and displace vapor that is present at time of liquid entry. However, sizing a vent line for receiver vapor displacement by incoming condensate is substantially different than the significantly larger vapor volume of flash steam.

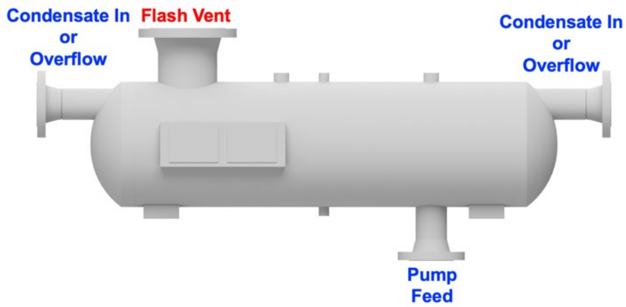
When steam traps discharge near-to-steam temperature condensate to a lower pressure, a percentage of the condensate flashes into steam.

When the pump receiver vent is sized only to equalize for liquid inflow, by default it can be undersized for incoming flash steam. The receiver can become pressurized and elevate condensate temperature to that of saturation for the corresponding steam pressure. For example, just a 2.5 psig steam pressure increase results in a 220°F vapor temperature. The table below demonstrates the different vapor pressures of 200°F, 210°F, and 220°F condensate, and when performing $NPSH_A$ calculations, the change from 11.53 to 17.19 represents a significant increase which directly decreases $NPSH_A$ – Net Positive Suction Head ***Available*** - and can cause pump cavitation.



Whether electric or non-electric condensate pumps are used, high temperature condensate should be flashed in a properly designed and sized vessel such as the one shown below. Flash steam rises through the flash vent and condensate flows by gravity into the pump to be discharged against the back pressure.

Temp, deg F	Pressure (psia)
190	9.34
195	10.38
200	11.53
205	12.77
210	14.12
212	14.7
215	15.59
220	17.19



The flash receiver/flash tank/flash vessel can be of vertical or horizontal design based on allowable respective velocities through the tank and associated piping. The proper sizing of the flash vent is critical to maintaining atmospheric pressure and resulting lower temperature condensate.

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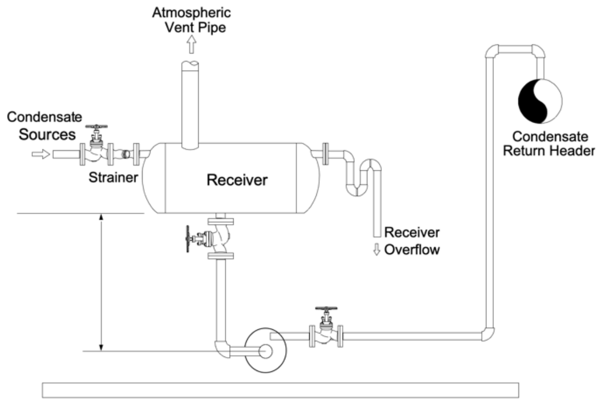
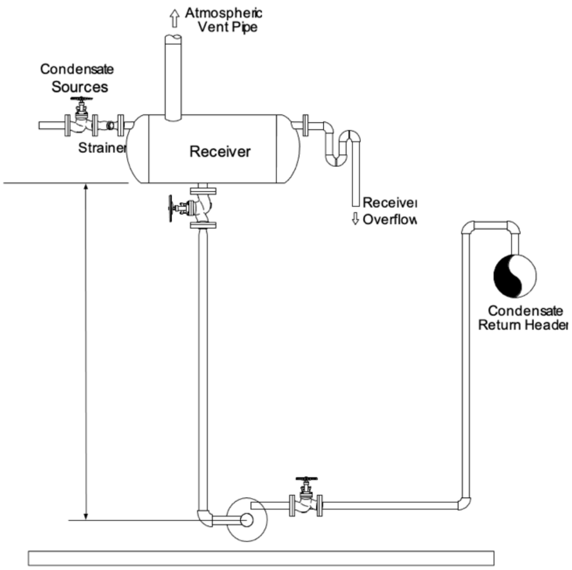
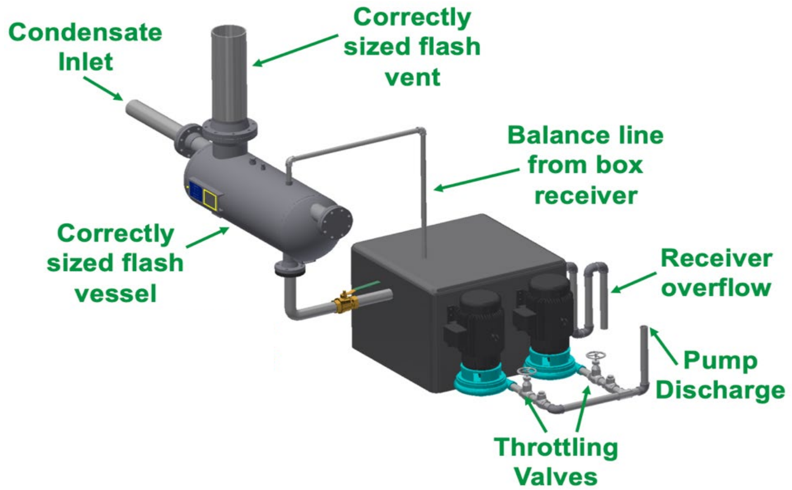
There are multiple factors that determine the non-flashing condensate temperature feeding into the pump. Electric pumps can be particularly susceptible to cavitation due to flashing from high impeller speed which causes a drop in fluid's static pressure. The potential for flashing is reduced by increasing the $NPSH_A$, or by reducing condensate temperature. Elevating the receiver where possible may be a more practical alternative to a heat exchanger. In comparing the two different receiver/pump installations below, the pumping system on the right will have greater $NPSH_A$ (if all other factors remain the same), thereby reducing the risk of flashing and resultant cavitation.





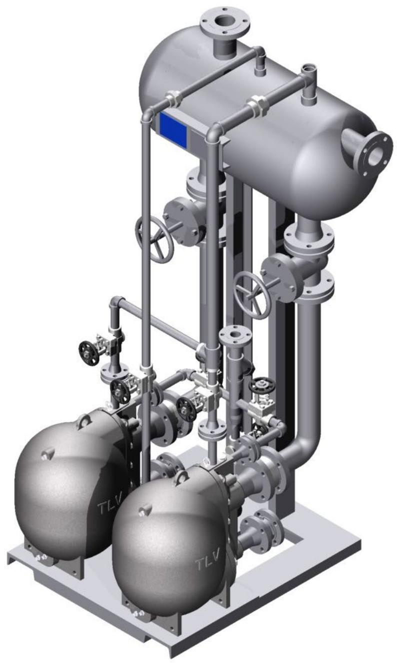
Once the $NPSH_A$ is optimized according to system design, the pump can be selected and properly sized. To avoid cavitation, an electric pump's $NPSH_R$ – Net Positive Suction Head ***Required*** - must be carefully chosen to be less than the $NPSH_A$. A basic installation design for a floor-mounted electric condensate pump (including a properly sized flash vessel) is shown below.



Flash receiver tanks/vessels are also required for non-electric condensate pumps (also known as "Type I secondary pressure drainers (SPD-I)," but for different reasons than $NPSH_R$ since non-electric pumps do not cavitate. However, if condensate is allowed to flash in an SPD-I pump, it can prevent the internal valve mechanism from operating properly and result in improper operation. Therefore, examples of flash tanks used with either single or double SPD-I pumps are shown in the diagrams below.

Although cavitation is not a concern with SPD-I systems, there can be a benefit to ***higher*** flash receiver elevation in that the condensate pumps may provide increased flow rate capacity as compared to the same unit with a lower elevation tank.

It is recommended that each respective manufacturer of electric or non-electric pumps design an appropriate flash tank/receiver/vessel in accordance with recognized standards to mitigate premature failure and support reliable operation.



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