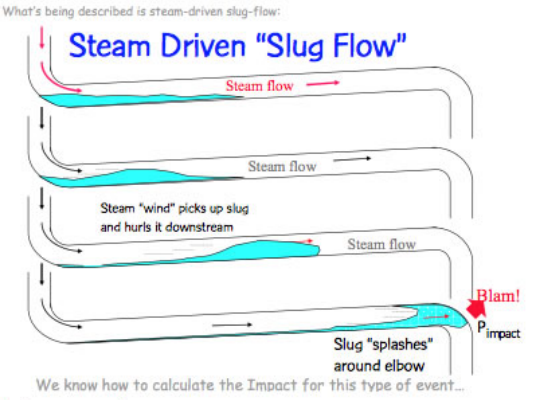
Water Hammer Seminar Quiz

KIRSNER CONSULTING ENGINEERING



1. To have a water hammer event in a steam system, there must be a large volume flow of fast-moving steam. (True or False)

2. Condensate lying dormant in a steam system that is suddenly exposed to steam can flash and expand causing a "waterhammer" over-pressurization. (True or False)

3. Fast flowing steam picking up a slug of condensate and flinging it against an elbow is not, technically, water hammer. (True or False). Can a collision of this type actually rupture a pipe? (Yes or No).

4 When steam becomes enveloped in cool condensate so that it rapidly condenses, its pressure drastically increases or decreases?

5. Is water hammer more , less, or equally likely in an uninsulated steam line? Why?

6. Pooled condensate beneath flowing saturated steam will eventually evaporate, if given enough time. (True or False)

7. You have two replacement valves to choose from in the shop --a Class 150 or a Class 250 Valve (both of which are labeled on the valve body casting). Which is more resistant to failure in the event of a water hammer? (Class 150 or Class 250)

8. You're replacing a 3/4" bucket trap with another from the same manufacturer. The cast iron bodies are identical and marked with raised letters on the castings indicating their "Design Pressure" is 250 psi. The older trap worked just fine in your 225 psi steam system until it failed. There's no reason the new trap shouldn't work just fine too? (True or False)

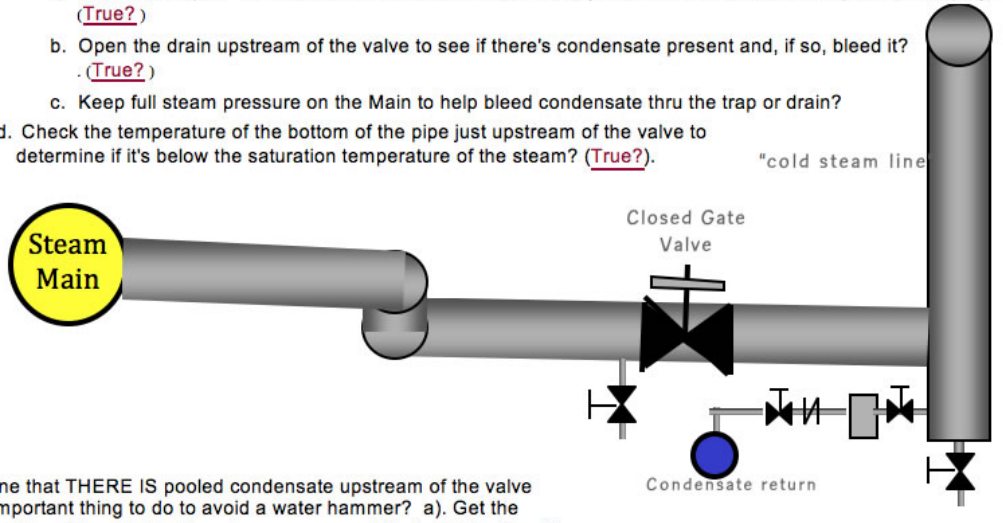
9. You're about to activate the cold steam line below by opening the closed gate valve to admit steam from the Main. Color in the precise level to which condensate would collect if you could see thru the pipe. To activate the riser downstream of the valve, you should—

a. Just "crack open" the isolation valve to admit steam slowly and let the downstream trap come into play. (True?)

b. Open the drain upstream of the valve to see if there's condensate present and, if so, bleed it? . (True?)

c. Keep full steam pressure on the Main to help bleed condensate thru the trap or drain?

d. Check the temperature of the bottom of the pipe just upstream of the valve to determine if it's below the saturation temperature of the steam? (True?).

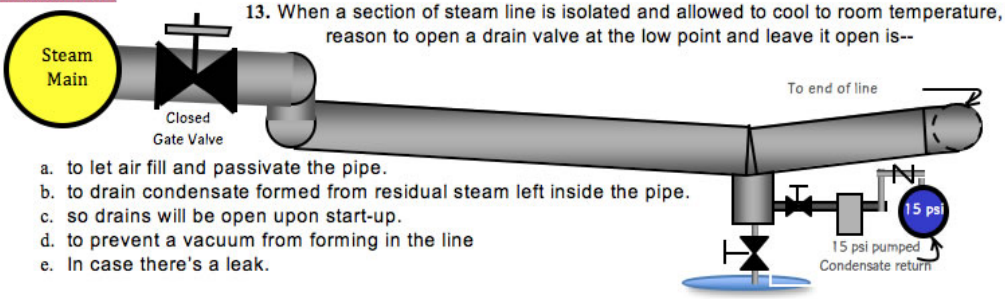


10. Suppose you determine that THERE IS pooled condensate upstream of the valve above. What's the most important thing to do to avoid a water hammer? a). Get the condensate out of the pipe (True?), or b). Cut the steam pressure off in the Main (True?)

11. Suppose you elect to use an infrared gun to measure pipe temperature. What factors MUST you be aware of to get an accurate temperature measurement using an infrared gun? a. color of the object (True ?), b. emissivity of the object (True ?), c. field of vision of the gun (True ?), d. temperature of the surrounding ambient air (True ?).

12. What's wrong with the design of the steam piping in the diagram above?

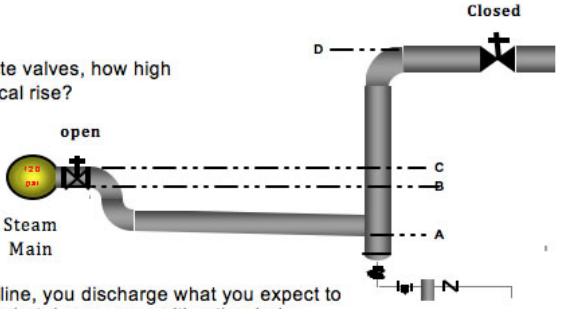
13. When a section of steam line is isolated and allowed to cool to room temperature, the most important reason to open a drain valve at the low point and leave it open is--



a. to let air fill and passivate the pipe.
b. to drain condensate formed from residual steam left inside the pipe.
c. so drains will be open upon start-up.
d. to prevent a vacuum from forming in the line
e. In case there's a leak.

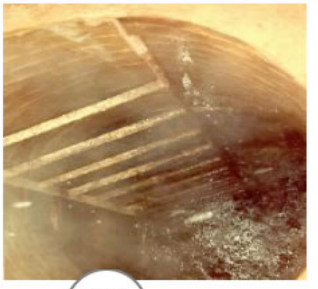
14. During warm-up/start-up of a 350' long 10" cold steam main from 62oF to the saturated steam temperature of 142 psig steam (362oF), about 450 #'s of condensate will form in less than 5 minutes in the steam line. If air is vented but no drain is opened and only a trap at the low point in the line is to be relied upon to drain the condensate to the condensate return system, roughly what percentage of the warm-up condensate load will accumulate in the line before the trap begins to discharge any condensate? a) 0%, b) 10%, c) 25%, d) 50%. e) more than 50%.

15. The steam trap at right has failed closed. Noting the position of the gate valves, how high can the level of condensate be expected to build over time in the vertical rise? A., B., C., or D ?



16. If the steam in the Main at right were superheated, would any condensate at all build-up in the lines even if the trap failed? No, Yes.

17. Checking for a condensate back-up at a drip leg on a 100 psig steam line, you discharge what you expect to be slightly subcooled 100 psi condensate thru a drain. If you're right, what do you see exiting the drain:
a. condensate flowing out the drain with a small portion turning to vapor that wafts up from the condensate.
b. Blowing steam with a small dribble of condensate, but not as much steam as if the drain were blowing live steam with no condensate.
c. About ½ condensate and ½ steam
d. a vapor-cloud jetting out the drain more voluminous than if live steam were blowing out.



18. The water surrounding a steam main in a flooded manhole is boiling. What's likely going on inside the steam main? (Pipe is expanding due to rapid boiling, or Steam is leaking from pipe, or Pipe is beginning to corrode, or Condensate is filling pipe). Is this dangerous? Why?

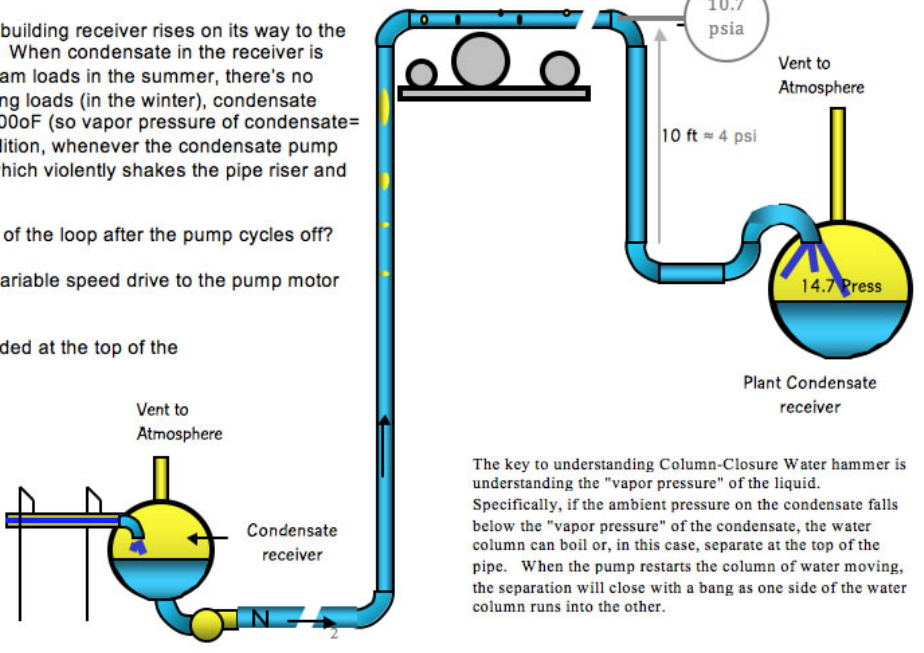
19. This Question deals with "Column-Closure" Waterhammer

Pumped condensate from a building receiver rises on its way to the Plant Condensate Receiver. When condensate in the receiver is relatively cool during low steam loads in the summer, there's no problem. But at high steaming loads (in the winter), condensate tank temperature exceeds 200oF (so vapor pressure of condensate= 11.4 psia). During this condition, whenever the condensate pump starts, there's a big "bang" which violently shakes the pipe riser and down comer.

What's happening at the top of the loop after the pump cycles off?

Would adding a "soft start" variable speed drive to the pump motor hurt or help?

Would a vacuum breaker added at the top of the pipe help?



The key to understanding Column-Closure Water hammer is understanding the "vapor pressure" of the liquid. Specifically, if the ambient pressure on the condensate falls below the "vapor pressure" of the condensate, the water column can boil or, in this case, separate at the top of the pipe. When the pump restarts the column of water moving, the separation will close with a bang as one side of the water column runs into the other.