Monday, March 1, 2021

Hydronic Expansion Tanks: Can I Pump into the Point of No Pressure Change (PNPC) to Reduce the Tank Size? (Part 1 of 3)

Monday Morning Minutes | by Norm Hall, March 1, 2021

We often design system after system and designate the sizing of expansion tanks to the newest employee on the team. It is just a matter of plugging in numbers. Occasionally a real challenge comes up in expansion tank sizing and location. This week I summarize a question received about pumping into the expansion tank instead of away from it. The last R. L. Deppmann Monday Morning Minutes on PNPC is a must-read prior to this one.

Expansion Tanks Are Just Too Big, What Should I Do?

Here is the story. An existing 8 story very large old structure will be gutted and renovated with retail and restaurants on the main level. The floors are 12 feet high and the heating equipment will be located on the main floor. The engineer is attempting to stay away from pressures over 120 PSIG. The pumps have 150 feet of head. This large system will have 12,000 gallons of water.

Traditional Point of No Pressure Change Location A

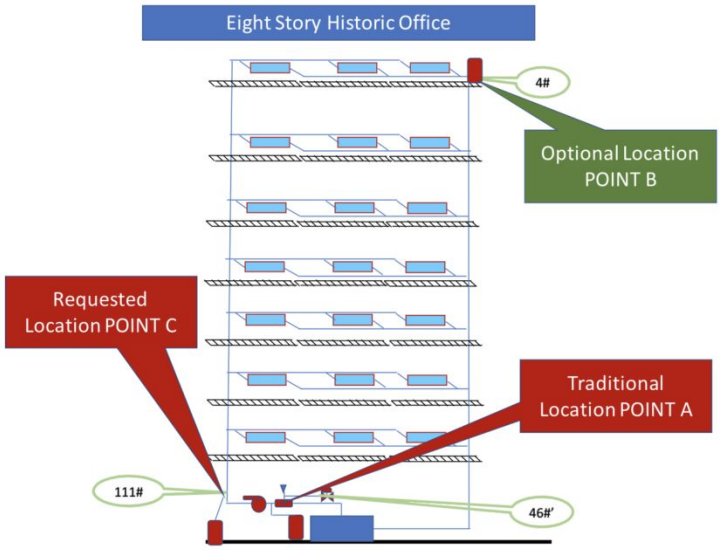


FIGURE 1 System started at cold fill with Pump on at full speed

With a cold fill requirement of 46 PSIG and a maximum pump discharge pressure of 120 PSIG when the system is hot, there is only a 9 PSIG allowable pressure increase. WOW, this will be a big tank. The expansion tank parameters are 12,000 gallons of water with a 46 PSIG fill pressure and a maximum pressure of 46+9=55 PSIG. The fill temperature is 40^{0}F and the maximum will be 180^{0}F. The system design has a 40^{0} ΔT, but the engineer wants to use the maximum temperature rather than the average temperature as a form of safety factor.

The expansion tank for this selection resulted in tanks which would not fit through doors or with the ceiling. The only solution that fit through the doors and made sense was (4) Bell & Gossett B-2500 which are each 48" X 100" which took up a lot of the mechanical room. The engineer looked for another solution.

Top of System HW Return Location B

An alternate solution would be the top of the system at location B. The engineer had previously read my blog; Hydronic Expansion Tank Location in a High Rise (part 1). Now the fill pressure was 4 PSIG and 13 PSIG maximum.

The tanks were much smaller but the weight of the tanks with the water was 15,000 lbs. which worried the engineer. The owner balked at giving up such valuable penthouse area for tanks.

Expansion Tank Selection: Locate on the Pump Discharge and Pump into the PNPC Location C

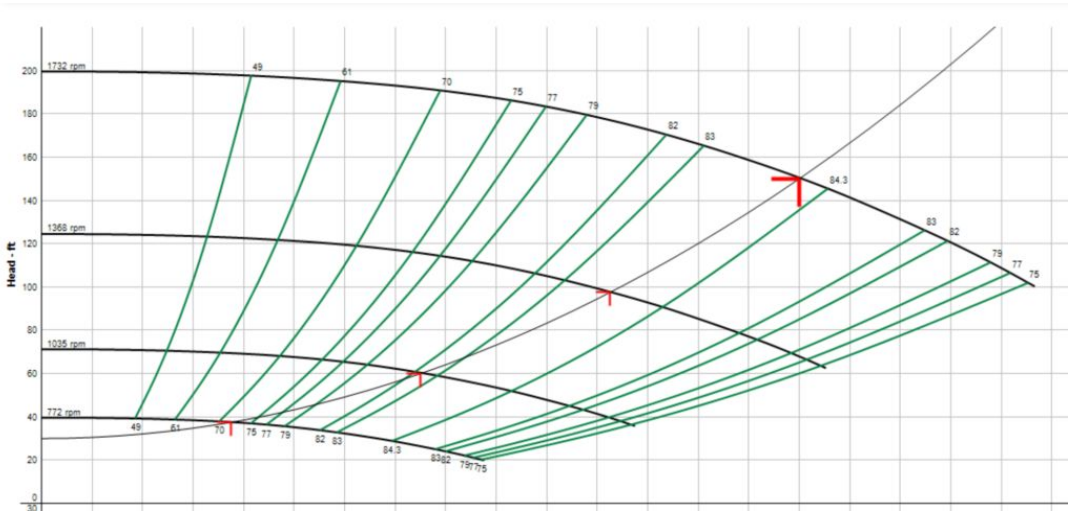
The engineer wanted to explore the idea of putting the tank on the discharge of the pump and making the maximum pressure in the tank 120 PSIG. The thought was since the pump head was 150 feet or 65 PSIG at design, if we raise the fill pressure a bit, we can keep the suction from going negative. The engineer wanted to raise the fill pressure to 70 PSIG so the suction would be 5 PSIG. (70-65=5).

The thought process is very laudable. The new location would assure a larger allowable pressure increase and smaller tanks.

Now the tanks on the main floor could be (2) Bell & Gossett B-2000 which are only 48” x 83”. In fact.

The problem is the hot water return pressure as we elevate in the system. The 5 PSIG of suction pressure would quickly go negative as we move up from floor to floor in the return pipe. That negative pressure would cause the same air issues I blogged about last week.

How Does Variable Speed Pumping Change the Story?



The engineer retorted with a thought-provoking idea. She really thought about this before our discussion. Her comments centered around variable speed pumping. Here are the main thoughts:

- The Pump head varies with the load. Based on this, the pump should be at its lowest flow and head and speed if the system is started up in the summer.
- As the load changes, the temperature reset will change also. The temperature will be lowest in the spring and the fall. The temperature will be greatest in the dead of winter.
- As the temperature in the system rises, so does that tank pressure.

Think about these points until we continue the blog. Next week, I'll give you some thoughts on another way to attack this. The following week I'll summarize the input you offered from this blog. Please join the conversation in this article and share your thoughts. I will be able to incorporate the comments into the R. L. Deppmann Monday Morning Minutes that publishes on March 15, 2021.