REFRIGERATION REVIEW

Hank's Rules of Thumb for Machinery Room Design

Machinery rooms need to have height. This works to the advantage in several ways. In addition, it should, if at all possible, have three outside walls. Having adequate height permits the use of vertical vessels, which in turn, in large machinery rooms permits compressor headers to be staggered in such a way that cross-over connections can be provided without a lot of "spaghettied" piping. Each compressor header needs to slope back to the vessel in such a way that if liquid does carry over it can drain back through a weep hole located inside the vessel on the bottom of the header.

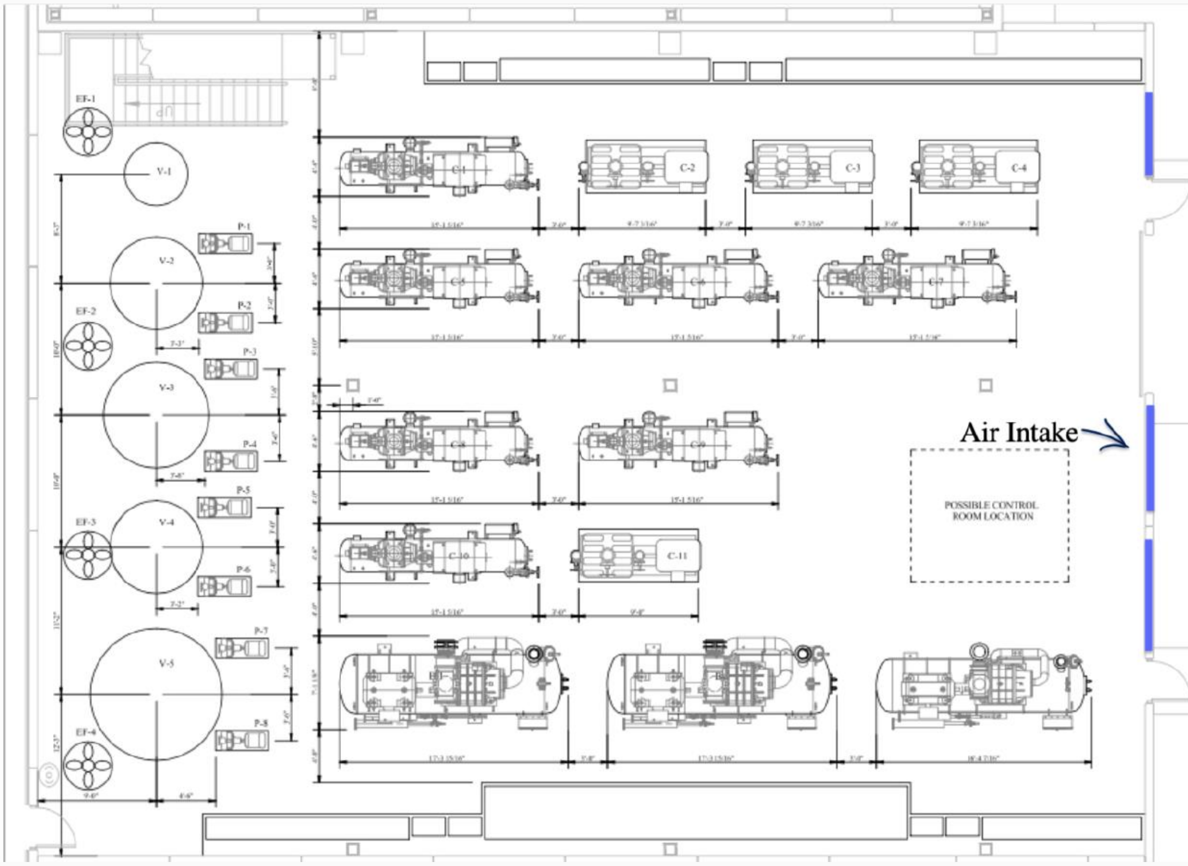
Also, the height facilitates in ventilating the machinery room with roof ventilation fans. Ammonia as a gas, once warmed, is lighter than air and will tend to rise. While IIAR has required using 10 air changes per hour, the NEC suggests 4 air changes per hour for open containers of flammable liquids such as gasoline in a garage environment. While IIAR is reconsidering the fixed air changes based on the cubic feet of the machinery room, the cfm requirement based on the pounds of ammonia in the system had been a realistic benchmark for years. IIAR was started back in the mid 1970s as the basis for getting the NEC to not require Division I Class 2 "explosion proof" electrical gear in the machinery room, if ventilation is provided in accordance to ASHRAE 15. The ASHRAE 15 standard recommends continuous ventilation or ventilation controlled by an ammonia detector if/when levels reach 1000 ppm. I recommend relying on continuous ventilation when possible, for sometime in the future an ammonia detector may not activate the ventilating system. When you consider the evaporation of liquid ammonia off the floor of a machinery room, which we estimate to be 6.8 pounds/cubic foot/hour, the dilution rate of continuous ventilation will keep it below IDLH levels.

We have attached below (Drawing A) a classic machinery room ventilating arrangement which brings air in at the bottom and takes it out the opposite side of the machinery room through the roof area. The exhaust fans are located strategically over the most likely places for ammonia leaks: near the vessels, pumps, and service valves for the vessels.

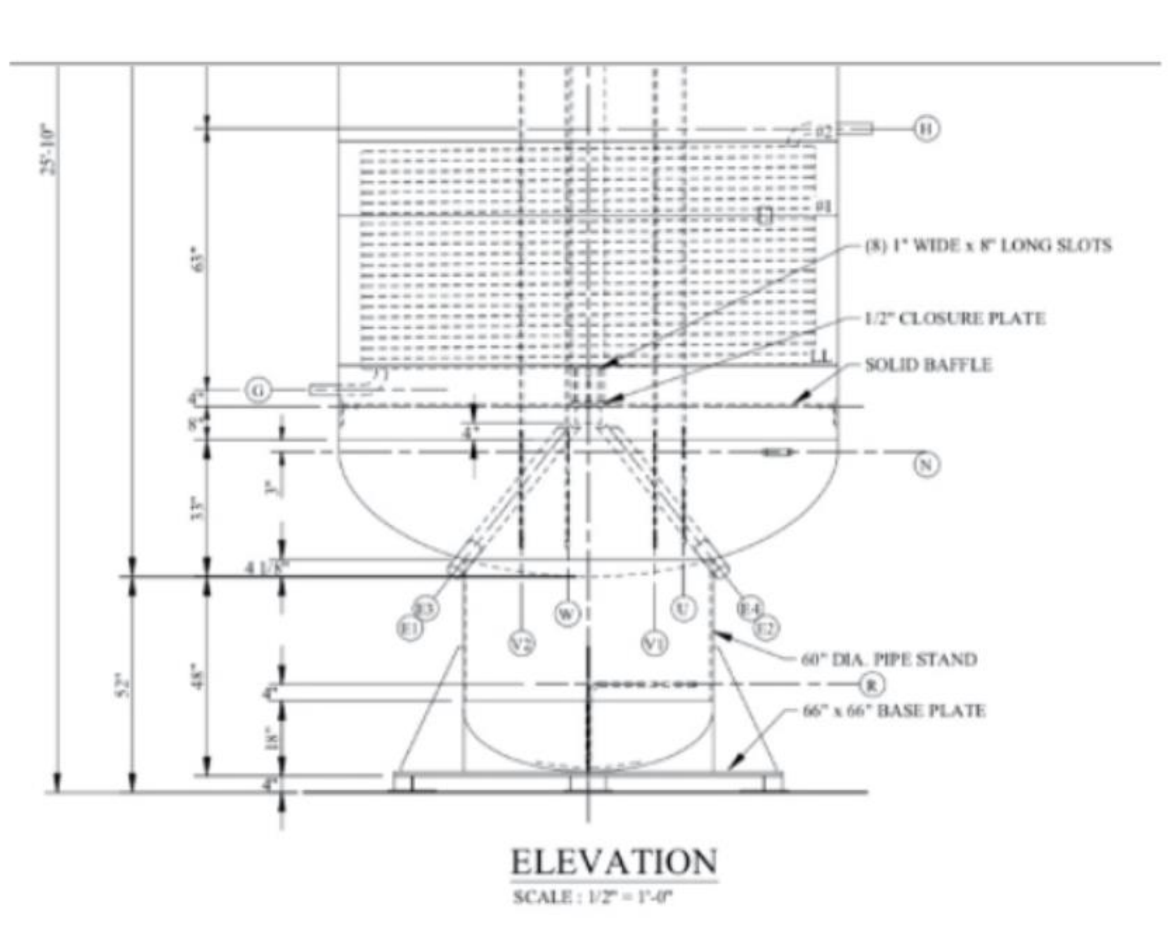
One method we try to employ in large machinery rooms is to take the hot gas off the top of the receiver rather than off the discharge header going to the condenser. There are several reasons for this; the primary one is that by taking it off the top of the receiver you tend to get a totally oil-free gas for defrosting and miscellaneous heat exchangers. Some will say you get hotter gas if you take it off the discharge; well, the sensible heat of the gas would be less than 10% of the total heat of the latent heat used. In northern climates particularly, the sensible heat would all be gone by the time the gas gets to the defrost controls. By having the hot gas line come out of the top of the receiver and assuring it slopes, not unlike the suction line, it would drain any liquid back to the receiver and not require local liquid floats to clear trapped areas of the hot gas line. This is important for several reasons, one is that trapped hot gas lines can cause liquid slugs sufficient to break refrigerant pipes and collapse float balls in the system. While it is generally not necessary to insulate hot gas lines, in large systems with long lines of 1000' or more, it can be considered, but if the line is sloped and sized sufficient to permit liquid to drain back to the high pressure receiver while hot gas is moving in the opposite direction, you might as well take advantage of the condensing effect of the hot gas line. We already had discussions on the slope of suction lines (we prefer 1'' in 20'); this would apply to hot gas lines as well.

While the design of intercoolers will be dealt with as a separate newsletter, generally we would estimate 2' per ton (TR) for subcooling requirements of a subcooling coil, which is our preferred way of subcooling liquid, as opposed to flash cooling, which is a far more disruptive process, and it is very difficult to maintain steady state conditions. Flash cooling causes significant spikes in compressor loads, which can be significantly reduced by using subcooling coils in the intercooler.

Generally, we will design the recirculating suction lines in the order of 1° lost per 100'. If it is a long suction line, say 1000' or so, we will make that closer to 1/2° per 100'. While we will cover the design of recirculating vessels in more detail in a future newsletter, one aspect of vessels which minimizes oil retention and cavitation from pump suction inlets is the use of flat baffle plates above the pump suctions. While this has been discussed in a previous newsletter, it is noteworthy to mention again that pump suctions at an angle internal in the vessel give the inlet an elliptical opening that helps eliminate any vortexing at the inlet. This is shown in Drawing B.



Drawing A: Machinery Room Ventilation



Drawing B: Vessel Baffle