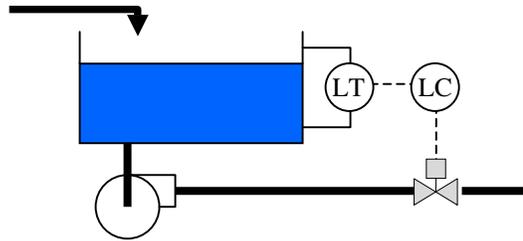


HVA 240
Principles of Process Control
Assignment #1
September 8, 2006

Solve the following problems on a separate sheet of paper. In the case of problems requiring computation, show the steps in your work to obtain your answer. Remember to reference the source of your data.

1) The input elements of an electronic controller accept a set point of 0 to 60 gpm and produce an output signal of 4 to 20 mA to the comparator. What is the sensitivity of these input elements?

2) The level control system shown uses a level sensor/transmitter (LT) and sends the signal to a level controller (LC). The controller manipulates valve position to increase or decrease the flow out of the tank to maintain the desired level. Develop a functional layout (block diagram) of the control loop for this system.



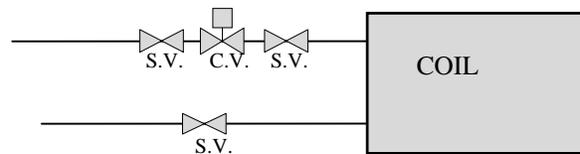
3) A pneumatically operated control valve has a rated flow coefficient, C_v , of 2.5 gal/min $\text{psi}^{-1/2}$. Calculate the pressure drop across the valve at a wide-open condition at each of the following values of volumetric flow rate of water at a temperature of 60 °F.

a) 3.0 gal/min b) 6.0 gal/min c) 12.0 gal/min

4) For the same valve, calculate the volumetric flow rates of water at a temperature of 60 °F which would result in the following pressure drops across the valve at a wide-open condition:

a) 4.0 psi b) 22.0 psi c) 25.0 psi

5) In the subsystem shown, the pressure drop across the coil is 10 ft wg. The total pressure drop in the piping and service valves is 20 ft wg. The system controls a flow rate of 350 gpm. Select a proper control valve C_v .



6) A branch of a water flow system has a valve installed with a rated rangeability of 100:1. The maximum design flow rate is 350 gpm. The branch in which this valve is installed has a TOTAL P.D. (including the valve) of 75 ft wg. The valve has a C_v of 100 GPM $\text{PSI}^{-1/2}$. If this system is required to have a cracking flow of not greater than 5 gpm, is this valve an appropriate choice? Fully explain your answer.

7) Assume the valve in problem 6 has a recovery coefficient of 0.4. It controls hot water at 250 °F. The pressure at the valve inlet is 35 psig. Will this valve cavitate? Fully qualify your answer.

If it does cavitate, how would you prevent cavitation from occurring?