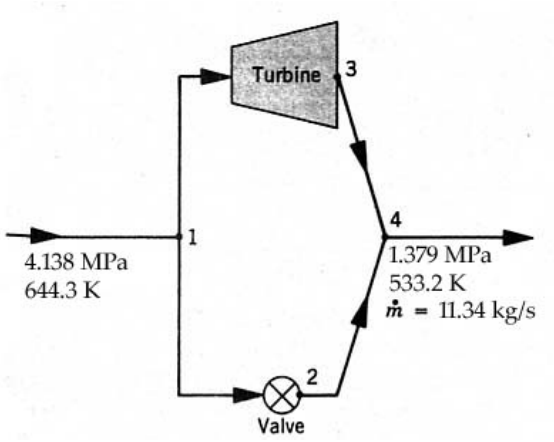
Unified Engineering Spring 2008
Thermodynamics & Propulsion Z. S. Spakovszky

(Add a short summary of the concepts you are using to solve the problem)

Problem T1

The figure shows a throttling valve in parallel with an ideal turbine. For operation at steady state, determine the air mass flow rate through the turbine and the power developed by the turbine. Draw the processes in an *h-s* diagram. Heat transfer with the surroundings and kinetic and potential energy effects can be neglected.



(Add a short summary of the concepts you are using to solve the problem)

Problem T2

a) What is the specific volume of a liquid-vapor mixture of water at 100°C if the quality of the mixture is 10 %?

b) A tank of volume 2 m^3 contains 0.5 m^3 of liquid water at 50 kPa pressure. The remaining volume is occupied by the vapor phase. What is the quality of the mixture in the tank? What is the total mass (kg) of the pure substance (liquid plus vapor) present?

Problem T3

A rigid, insulated vessel is fitted with a single port for filling and emptying. Initially, the valve on the port is closed after the vessel has been evacuated. The vessel is to be filled with steam from a steam line with constant supply conditions of p = 10 bar, and T = 300°C. The valve is opened and the steam is allowed to flow until the pressure in the vessel reaches 10 bar. At this time the valve is closed.

a) What is the temperature of the steam in the vessel the instant the valve is closed?

b) Why is the temperature of the steam in the vessel different from the temperature of the steam in the charging line at the instant mechanical equilibrium is established between the contents and the steam in the steam line?

c) The steam is now allowed to come to thermal equilibrium with the environment at 40°C. What is the pressure on the steam in the vessel at this time? Draw the p-V diagram.

d) What is the heat transfer for the steam during the thermal equilibration process?