(b) states 2 and 02 are the actual and stagnation states of the fluid leaving the diffuser.

(4) The velocity coefficient C_v is defined:

$$C_v = \frac{\text{Actual velocity at nozzle exit}}{\text{Velocity at nozzle exit with isentropic flow and same exit pressure}}$$

REVIEW PROBLEMS

PROBLEM 1

Determine the final equilibrium state in English units when 2 lbm of saturated liquid mercury at 1 psia is mixed with 4 lbm of mercury vapor at 1 psia and 1,400°F. During the process the pressure in the cylinder is kept constant and no energy is lost between the cylinder and mercury.

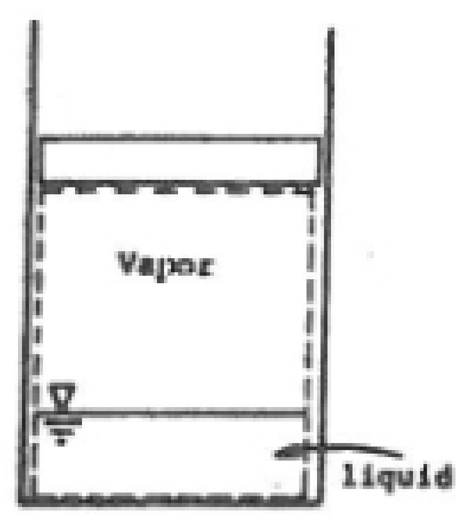
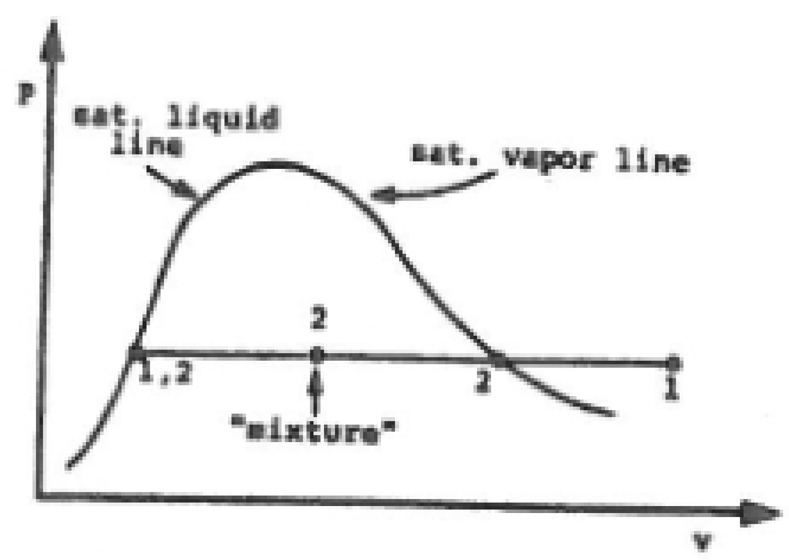


Figure 34. (a) The control mass



(b) The process representation

SOLUTION

Since the amount of liquid might change during the process, the liquid or only the vapor cannot be taken as the control mass. Instead, take the entire 6 lbm of mercury. By assumption, no energy transfer as heat occurs, but the volume is expected to change, resulting in an energy transfer as work. The only energy stored within the control mass is the internal energy of the mercury; the energy balance, made over the time for the process to take place, is therefore (Figures 34 and 35)

W	=	ΔU
energy input		increase in energy storage

where $\Delta U = U_2 - U_1$

The work calculation is made easy by the fact that the pressure is constant. When the piston moves an amount dx, the energy transfer as work from the environment to the control mass is

$$dW = PAdx = -PdV.$$

Integrating,

$$W = \int_{1}^{2} -PdV = P\left(V_1 - V_2\right).$$

Combining with the energy balance obtain

$$U_2 + PV_2 = U_1 + PV_1 \tag{1}$$

TABLE 3
PROPERTIES OF SATURATED MERCURY

		Enthalpy, Btu/lbm		
P, psia	**T,°F**	**Sat. liq.**	**Evap.**	**Sat. vap.**
0.010	233.57	6.668	127.732	134.400
0.020	259.88	7.532	127.614	135.146
0.030	276.22	8.068	127.540	135.608
0.050	297.97	8.778	127.442	136.220
0.100	329.73	9.814	127.300	137.114
0.200	364.25	10.936	127.144	138.080
0.300	385.92	11.639	127.047	138.086
0.400	401.98	12.159	126.975	139.134
0.500	415.00	12.568	126.916	139.484
0.600	425.82	12.929	126.868	139.797
0.800	443.50	13.500	126.788	140.288
1.00	457.72	13.959	126.724	140.683
2.00	504.93	15.476	126.512	141.988
3.00	535.25	16.439	126.377	142.816
5.00	575.70	17.741	126.193	143.934

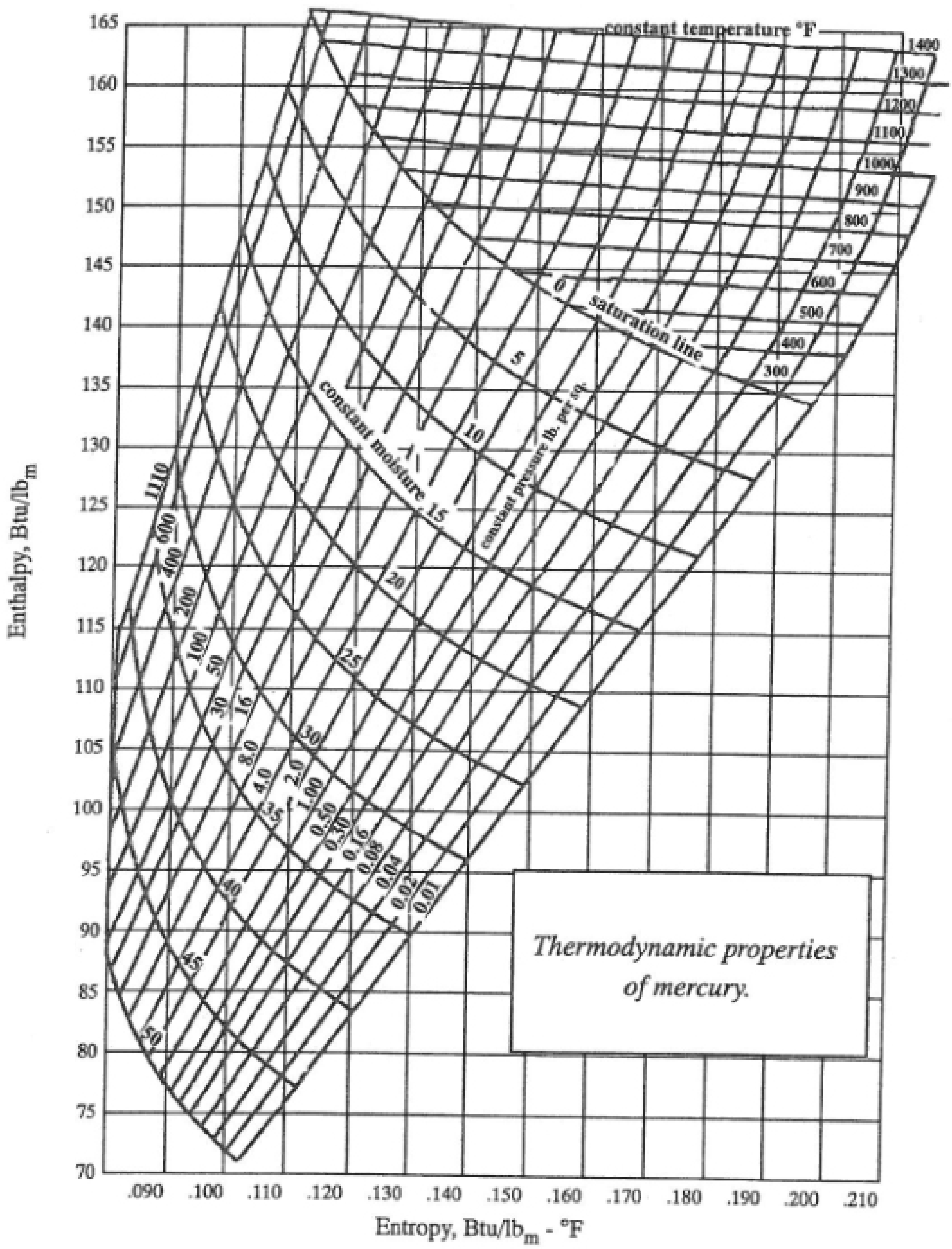


Figure 35. Thermodynamic properties of mercury

To evaluate the initial terms assume that the liquid is in an equilibrium state and the vapor is in an equilibrium state, even though they are not in equilibrium with one another. The graphical and tabular equations