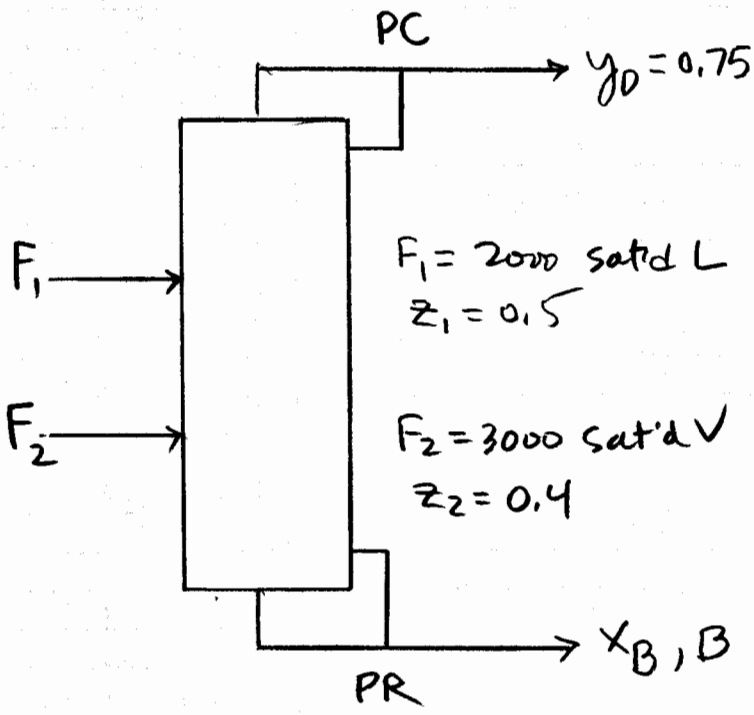


$F = F_1 + F_2 = 2000 + 3000 = 5000$

$Fz = F_1 z_1 + F_2 z_2 = 2000(0.5) + 3000(0.4) = 2200$

$\therefore z = \frac{2200}{5000} = 0.44$

$F = D + B \qquad y_D = 0.75 = \frac{0.95(2200)}{D} = \frac{2090}{D}$

$\therefore D = 2786.\overline{66}$

$\therefore B = F - D = 2213.\overline{33}$

$\therefore x_B = \frac{(1-0.95)(2200)}{2213.\overline{33}} = 0.050$

TOL $\qquad y = \left(\frac{R}{R+1}\right)x + \frac{1}{R+1} y_D \qquad (7\text{-}9)$

$\therefore y_{int} = \frac{y_D}{R+1} \qquad \therefore R+1 = \frac{y_D}{y_{int}} = \frac{0.75}{0.46} = 1.6304$

$\therefore R_{min} = 0.6304 = (L/D)_{min}$

$R_{act} = 2 R_{min} = 1.2608$

$\therefore y_{int} = \frac{y_D}{R+1} = \frac{0.75}{2.2608} = 0.3317$

[Construct TOL, FOL_1, FOL_2, BOL]

Determine MOL from intersection points.

Note: $R = 1.2608 = \frac{L}{D} = \frac{L}{2786.66}$

$\therefore L = 3513.4$

$V = L + D = 6300$

(see complete flow analysis next page)

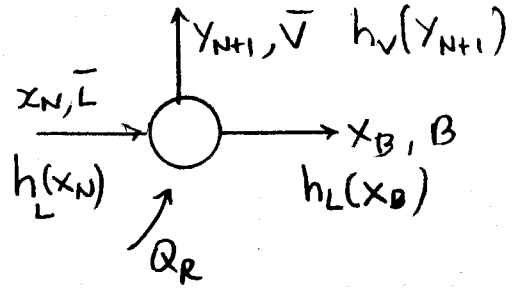
(a) Total Stages 5.5 (7.5 including PC & PR)

(b) Feed # 1 on stage 4

(c) Feed # 2 on stage 6

(d) $\frac{V_{N+1}}{L_N} = \frac{3300}{5513.4} = 0.600$

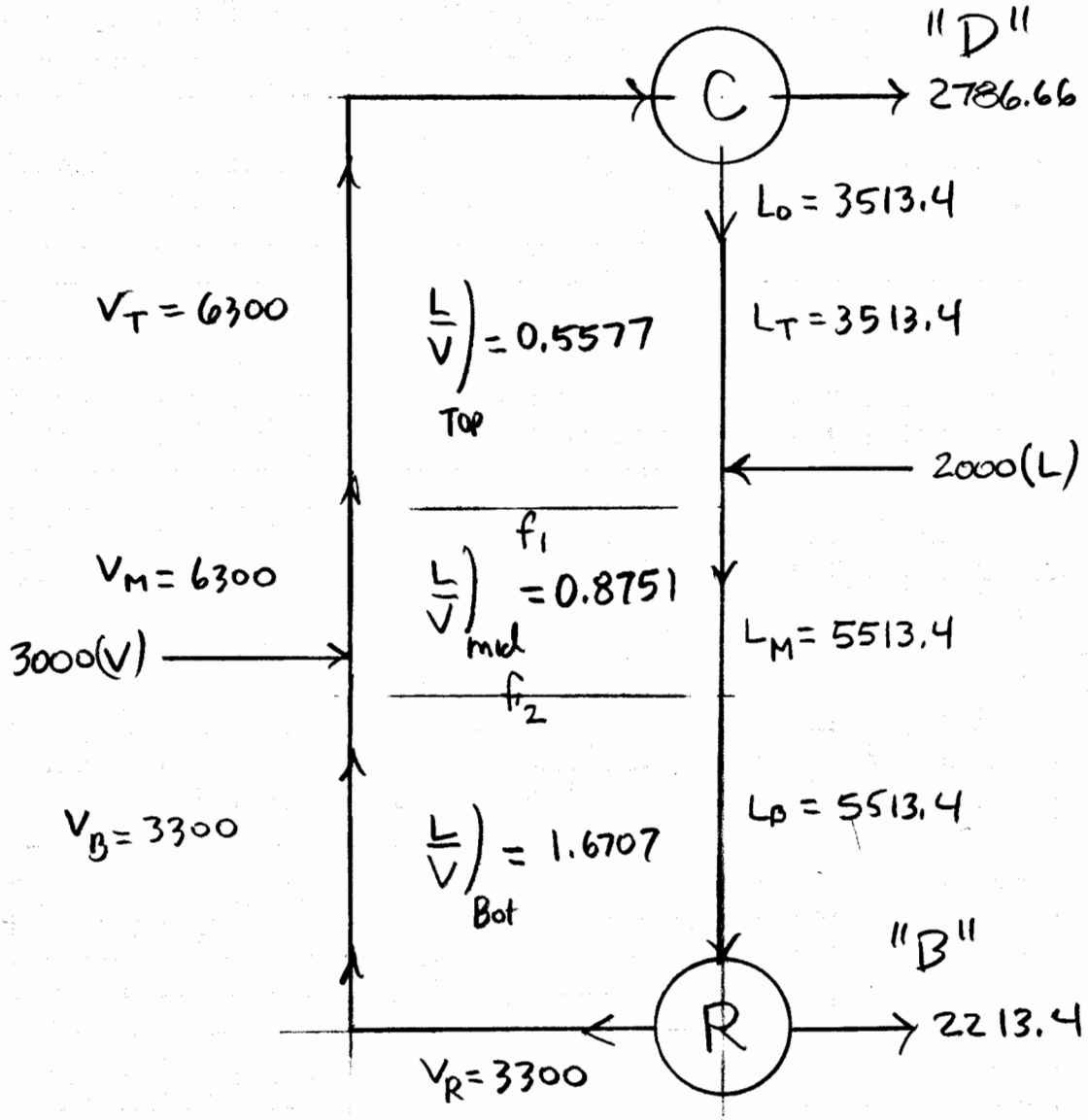
e)



$Q_R = \bar{V} h_V + B h_L(x_B) - \bar{L} h_L(x_N)$

$= 3300(\ ,\ ) + 2213.4(\ ,\ ) + 5513.4(\ ,\ )$

20,800 2700 2700


"D"
2786.66
C
$L_D = 3513.4$
$V_T = 6300$
$\left(\frac{L}{V}\right)_{Top} = 0.5577$
$L_T = 3513.4$
2000(L)
f_1
$V_M = 6300$
$\left(\frac{L}{V}\right)_{mid} = 0.8751$
3000(V)
$L_M = 5513.4$
f_2
$V_B = 3300$
$\left(\frac{L}{V}\right)_{Bot} = 1.6707$
$L_B = 5513.4$
"B"
2213.4
R
$V_R = 3300$

$Q_R = 68,640,000 + 5,976,000 - 14,886,000$

$Q_R = 59.73 \times 10^6 \frac{Btu}{h} = 17,505\ kW$

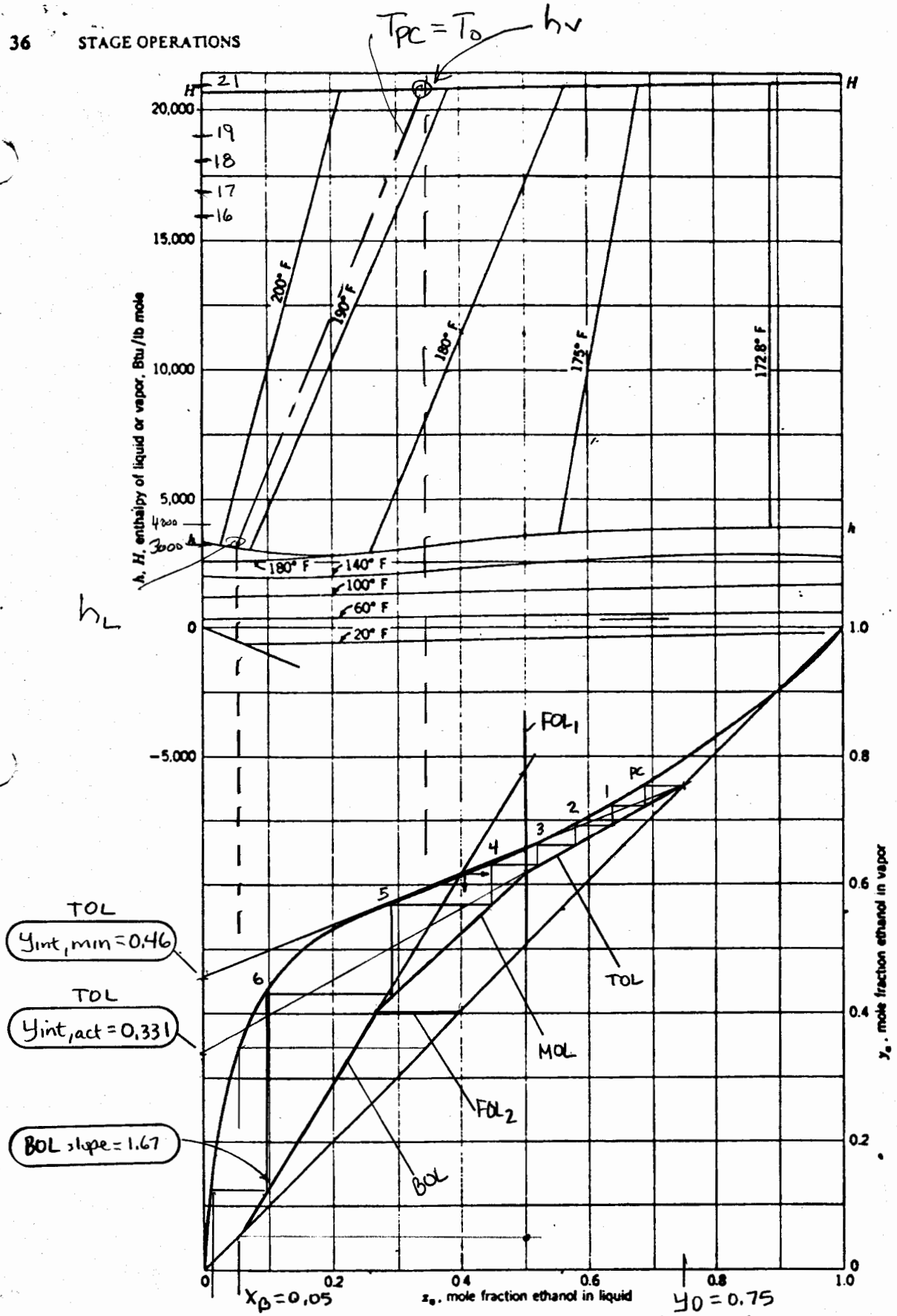


Figure 3.4. Enthalpy-composition diagram for ethanol-water mixtures at 1 atm pressure (3). Reference state: liquid water at 32°F, liquid ethanol at 32°. (By permission of John Wiley; copyright © 1950.)