

3-87 Determine the specific volume of nitrogen gas at 10 MPa and 150 K based on (a) the ideal-gas equation and (b) the generalized compressibility chart. Compare these results with the experimental value of $0.002388 \text{ m}^3/\text{kg}$, and determine the error involved in each case. Answers: (a) $0.004452 \text{ m}^3/\text{kg}$, 86.4 percent; (b) $0.002404 \text{ m}^3/\text{kg}$, 0.7 percent

N_2 , $P = 10 \text{ MPa}$, $T = 150 \text{ K}$, FIND v FOR:

a) IDEAL GAS RELATION

$$v = \frac{RT}{P} = \frac{(0.2968 \frac{\text{kJ}}{\text{kg}\cdot\text{K}})(150 \text{ K})}{(10 \text{ MPa}) \left(\frac{1000 \text{ kPa}}{\text{MPa}} \right)} = 0.004452 \frac{\text{m}^3}{\text{kg}}$$

b) GENERALIZED COMPRESSIBILITY CHART

$$P_r = \frac{P}{P_{CR}} = \frac{(10 \text{ MPa})}{(3.39 \text{ MPa})} = 2.95$$

$$T_r = \frac{T}{T_{CR}} = \frac{(150 \text{ K})}{(126.2 \text{ K})} = 1.19$$

$$\text{FIG. A-15: } z = 0.53 = \frac{v_{\text{ACTUAL}}}{v_{\text{IDEAL}}}$$

$$v_{\text{ACTUAL}} = (0.53) \left(0.004452 \frac{\text{m}^3}{\text{kg}} \right) = 0.002360 \frac{\text{m}^3}{\text{kg}}$$