

Given:

Isobutane is piped through a piping network with an inside diameter of 2 in.

Required:

If the volumetric flow rate at a particular point is 225 gallons per minute (gpm), what is the mass flow rate? What is the average velocity of the fluid?

Solution:

The inside diameter of the pipe is defined as

$$ID := 2 \text{ in}$$

The volumetric flow rate is defined as

$$V' := 225 \frac{\text{gal}}{\text{min}}$$

Going to Table A-3E(a) @ isobutane shows

$$\rho_{iso} := 37.1 \frac{\text{lbm}}{\text{ft}^3}$$

The mass flow rate is then found by

$$m' := \rho_{iso} \cdot V' = 18.60 \frac{\text{lbm}}{\text{s}}$$

The cross sectional area is found by

$$A_p := \frac{\pi}{4} \cdot ID^2 = 3.142 \text{ in}^2$$

The average velocity of the fluid is then

$$V_{avg} := \frac{V'}{A_p} = 22.98 \frac{\text{ft}}{\text{s}}$$