

Chapter 13

Gas Mixtures

Study Guide in PowerPoint

to accompany

Thermodynamics: An Engineering Approach, 8th edition
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The discussions in this chapter are restricted to nonreactive ideal-gas mixtures. Those interested in real-gas mixtures are encouraged to study carefully the material presented in Chapter 12.

Many thermodynamic applications involve mixtures of ideal gases. That is, each of the gases in the mixture individually behaves as an ideal gas. In this section, we assume that the gases in the mixture do not react with one another to any significant degree.

We restrict ourselves to a study of only ideal-gas mixtures. An ideal gas is one in which the equation of state is given by

$$PV = mRT \quad \text{or} \quad PV = NR_v T$$

Air is an example of an ideal gas mixture and has the following approximate composition.

Component	% by Volume
N ₂	78.10
O ₂	20.95
Argon	0.92
CO ₂ + trace elements	0.03

Definitions

Consider a container having a volume V that is filled with a mixture of k different gases at a pressure P and a temperature T .

A mixture of two or more gases of fixed chemical composition is called a *nonreacting gas mixture*. Consider k gases in a rigid container as shown here. The properties of the mixture may be based on the mass of each component, called gravimetric analysis, or on the moles of each component, called molar analysis.

$$\begin{array}{l} k \text{ gases} \\ T = T_m \quad V = V_m \\ P = P_m \quad m = m_m \end{array}$$

The total mass of the mixture m_m and the total moles of mixture N_m are defined as

$$m_m = \sum_{i=1}^k m_i \quad \text{and} \quad N_m = \sum_{i=1}^k N_i$$