ECE 309 M.M. Yovanovich

Perfect Gas Relations

Compressibility

The **compressibilty** of a gas is defined as

$$z = \frac{P\,v}{R\,T}$$

where

$$\begin{aligned} \mathrm{P} &= \text{Pressure} \\ \mathrm{v} &= \text{Specific volume} \\ \mathrm{T} &= \text{Temperature} \\ \mathrm{R} &= \text{Universal gas constant} \end{aligned}$$

For ideal gases $z = 1$. For real gases:

$$z = z(P^\star, T^\star)$$

where $P^\star = P/P_{cr}$ and $T^\star = T/T_{cr}$.

If z for a real gas is close to one, then the gas can be modeled as an ideal gas. The condition will be satisfied when $P^\star << 1$ and $T^\star >> 1$.

$\mathbf{c_P, c_v, R}$ Relation

Since

$$h = u + P\,v$$

then

$$dh = du + d(Pv) = du + d(RT)$$

and

$$c_P\,dT = c_v\,dT + R\,dT$$

or

$$\boxed{c_P = c_v + R}$$

for an ideal gas. The two specific heats are weak functions of temperature.