Introduction:

Using the TH5-B equipment, our goal is to find the heat capacity ratio for air near standard temperature and pressure. Basic Thermodynamic elements such as adiabatic processes, properties of an ideal gas, and the first law of Thermodynamics will be implemented in this experiment.

Using air as the working fluid, the TH5-B is comprised of two vessels on a base plate and a freestanding electrical air pump. Both the vessels have a common base-plate but one vessel is larger than the other. The larger vessel is used for operation under pressure and the smaller vessel is used for operation under vacuum.

Both vessels are made from clear rigid plastic because it provides somewhat of insulation between air inside the vessels and its surroundings outside. Also, due to its clear rigid plastic make, the contents return to room temperature fairly quickly.

The following derivation is from the document “Heat Capacity Ratio – Expansion Processes of a Perfect Gas (TH5-B)” written by Dr. Kassegne for the ME495 Laboratory.

For a reversible adiabatic expansion, dq = 0

From the first law of thermodynamics, dU = dq + dW

Therefore during the expansion process, dU = dW = -pdV

At constant volume, the heat capacity ratio relates the change in temperature to change in internal energy:

dU = CvdT

Thus, CvdT = -pdV

Substituting in the ideal gas equation and then integrating gives:

Cv ln = -R ln

Now, for an ideal gas,

=

Therefore, Cv = = -R ln

Rearranging and substituting we get:

= - ln

During the return of temperature to the starting value,

=

Thus, ln = ln

Re-arranging gives the relationship in its required form:

=

The relationship above will be used in experimentally determining the ratio of specific heat capacities. We note the large reliance on the initial and final pressures of this formula. The experiment will rely heavily on the accurate recording of these pressures.