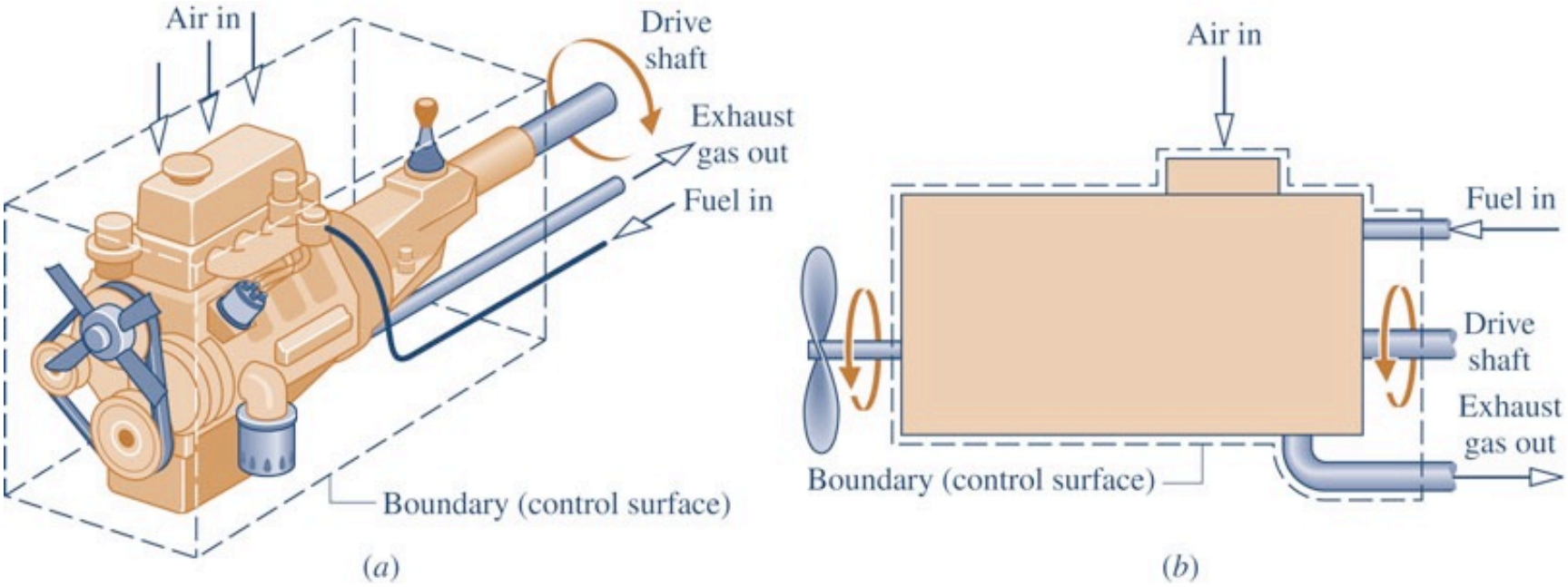
Control Volume

- A given region of space through which mass flows.
- Mass may cross the boundary of a control volume.



Macroscopic and Microscopic Views

►Systems can be described from the macroscopic and microscopic points of view.

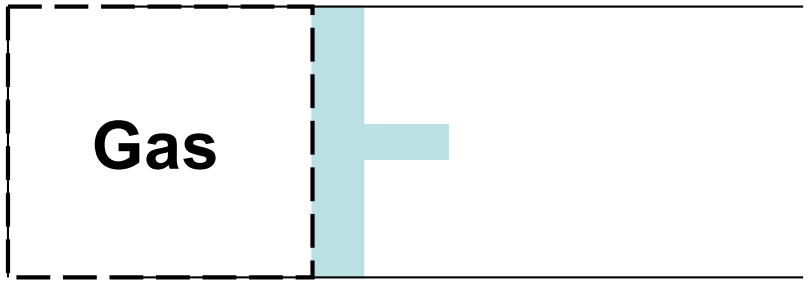
►The microscopic approach aims to characterize by statistical means the average behavior of the particles making up a system and use this information to describe the overall behavior of the system.

►The macroscopic approach describes system behavior in terms of the gross effects of the particles making up the system – specifically, effects that can be measured by instruments such a pressure gages and thermometers.

►Engineering thermodynamics predominately uses the macroscopic approach.

Property

- A macroscopic characteristic of a system to which a numerical value can be assigned at a given time without knowledge of the previous behavior of the system.
- For the system shown, examples include:
  - **Mass**
  - **Volume**
  - **Energy**
  - **Pressure**
  - **Temperature**



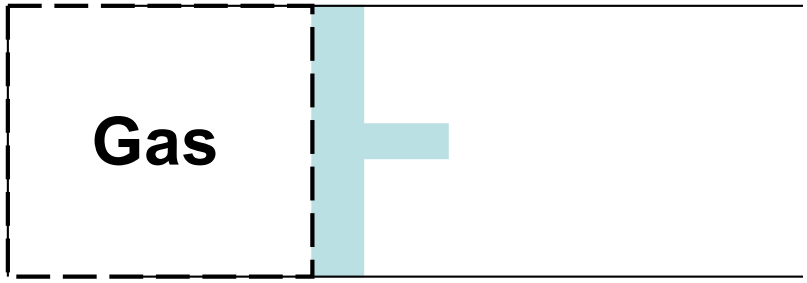
State

►The condition of a system as described by its properties.

►Example: The state of the system shown is described by $p, V, T, \ldots$.

►The state often can be specified by providing the values of a subset of its properties. All other properties can be determined in terms of these few.

State: $p, V, T, \ldots$



Process

►A transformation from one state to another.

►When any of the properties of a system changes, the state changes, and the system is said to have undergone a process.

►Example: Since $V_2 > V_1$, at least one property value changed, and the gas has undergone a process from State 1 to State 2.

State 1: $p_1, V_1, T_1, \ldots$ **State 2:** $p_2, V_2, T_2, \ldots$