Thermodynamic cycles

- Objectives
  1. Define a **thermodynamic cycle**
  2. Explore ways to **classify thermodynamic cycles**
  3. Apply **conservation of energy** to generic cycles
  4. Examine **cycle performance**

- Define thermodynamic cycle (Write a sentence!)

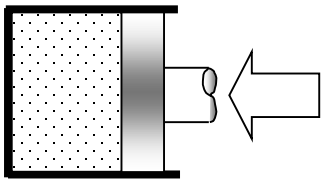
  Key Features:
  1) _____ system
  2) Periodically returns to its _____
  3) Series of _____

- Examples

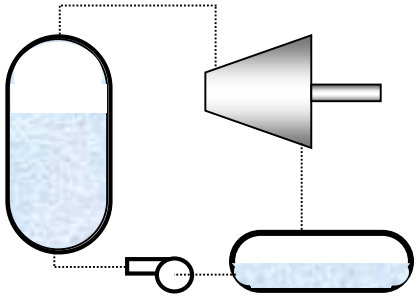
- Ways to classify
  - _____ _____
  - _____ _____
  - _____

Classification by structure

Closed, periodic cycles



Closed loop, steady-state cycles



How are these two systems the same?
How are these two systems different?
What's the important variable for describing property changes in each case?

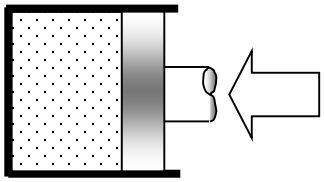
Characteristics

- Spatially uniform intensive properties
- Intensive properties vary *periodically with time*.

Characteristics

- Spatially varying intensive properties
- Intensive properties vary with location
- Interconnected components create continuous flow loop

Closed, periodic cycles



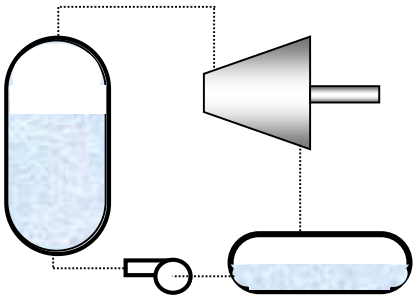
System is…

Conservation of energy:

Integrate energy *over one complete time cycle, t* → Δt

For a cycle

Closed loop, steady-state cycles



System is…

Conservation of energy:

For a cycle

… Structure (cont'd)

1) What conclusion can you draw form applying conservation of energy to the two cycles?

2) Imagine you are a lump of working fluid flowing in the closed-loop cycle. How would your property variation compare to the periodic cycle case?

3) What are some examples of each type of cycle?

Classification by purpose

- Power cycles (Heat engines)

- Refrigerators/heat pumps (Reversed cycles)

Comparing cycle performance

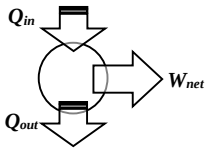
- To "buy" the best cycle, what do you need to compare?

_____ vs. _____

- Generic measure of performance (*MOP*)

MOP= _____

- **Power cycles**

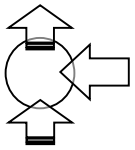


Desired effect

Cost

$MOP = \eta =$ _____

Thermal efficiency



- **Refrigeration/Heat pump cycles**

MOP = COP Coefficient of Performance

Heat pump

Desired effect

Cost

$COP_{HP} =$

Refrigerator

Desired effect

Cost

$COP_R =$