

Gas Power Cycles – Diesel Cycle

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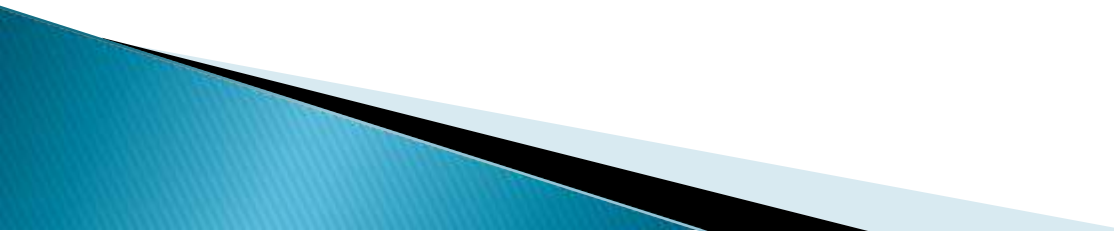
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Power Cycles – Introduction

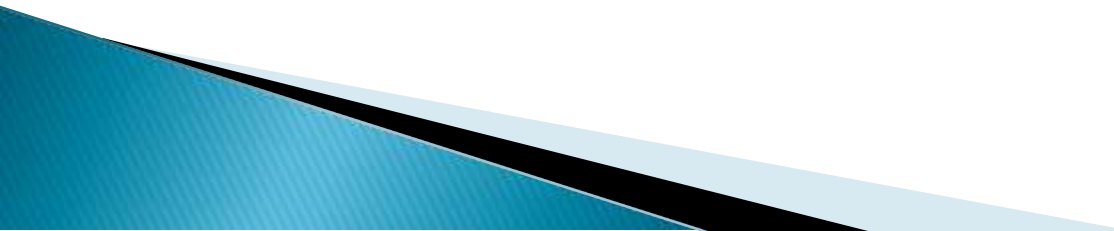
- ▶ The two important areas of application for thermodynamics are power generation and refrigeration
- ▶ The devices or systems used to produce a net power output are often called *engines*, and the thermodynamic cycles they operate on are called *power cycles*



Thermodynamic Cycles based on working fluid

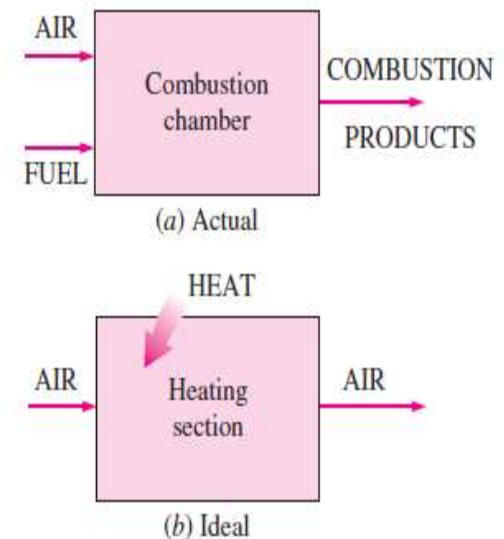
- ▶ Thermodynamic cycles can also be categorized as *gas cycles* and *vapor cycles*, depending on the *phase* of the working fluid.
 - ▶ In gas cycles, the working fluid remains in the gaseous phase throughout the entire cycle, whereas in vapor cycles the working fluid exists in the vapor phase during one part of the cycle and in the liquid phase during another part
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Closed and Open cycles

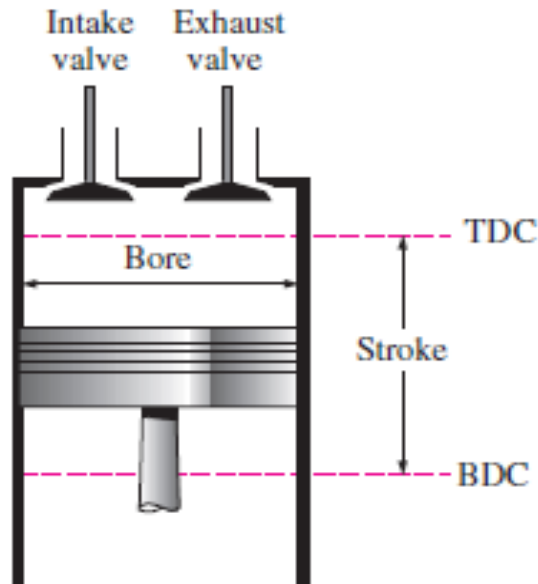
- ▶ Thermodynamic cycles can be categorized yet another way: *closed* and *open cycles*.
 - ▶ In closed cycles, the working fluid is returned to the initial state at the end of the cycle and is recirculated
 - ▶ In open cycles, the working fluid is renewed at the end of each cycle instead of being recirculated. In automobile engines, the combustion gases are exhausted and replaced by fresh air-fuel mixture at the end of each cycle
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Air Standard Assumptions

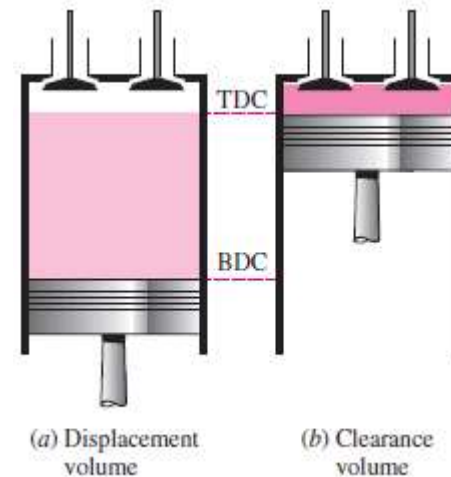
- ▶ The working fluid is air, which continuously circulates in a closed loop and always behaves as an ideal gas
- ▶ All the processes that make up the cycle are internally reversible
- ▶ The combustion process is replaced by a heat-addition process from an external source
- ▶ The exhaust process is replaced by a heat-rejection process that restores the working fluid to its initial state



Overview of Reciprocating Engines

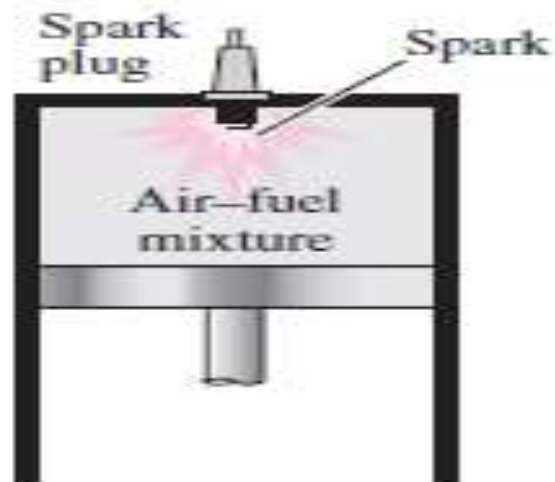


Nomenclature for reciprocating engines.



Displacement and clearance volumes of a reciprocating engine.

Diesel Cycle



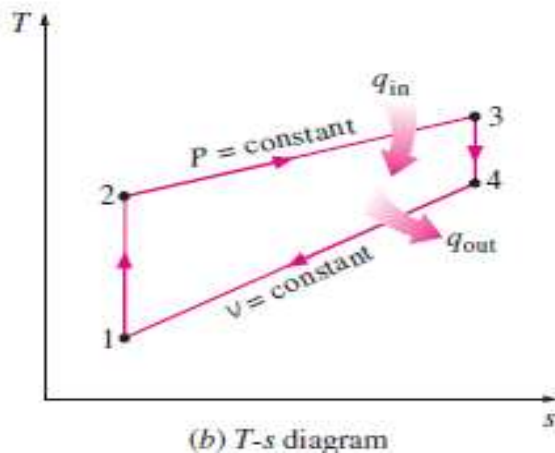
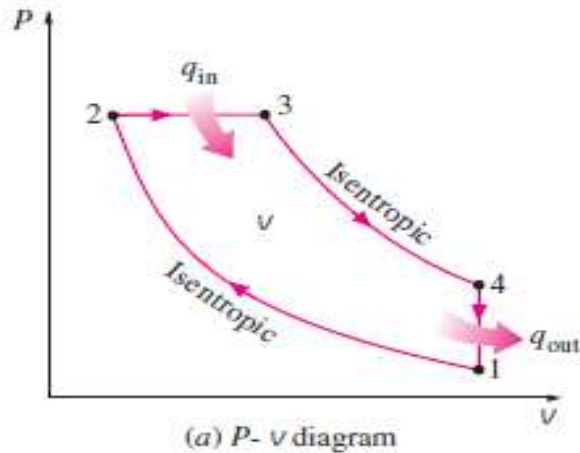
Gasoline engine



Diesel engine

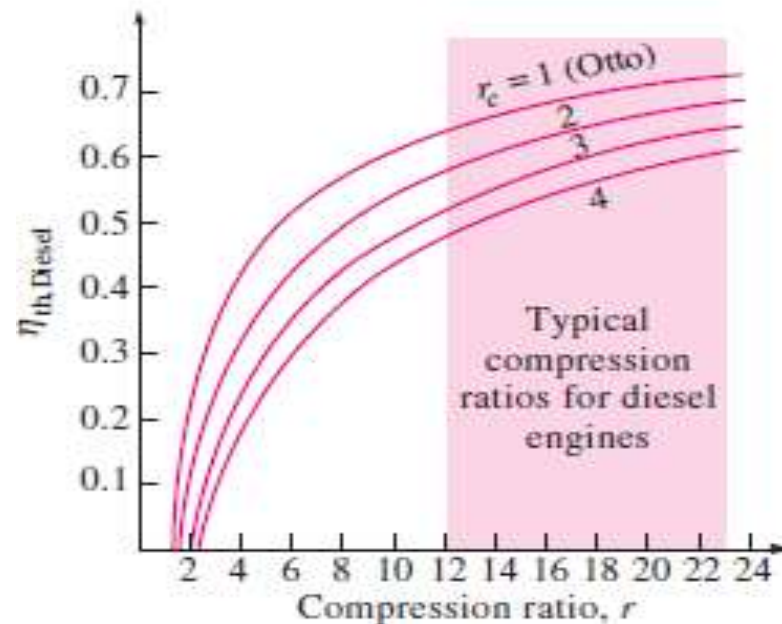
In diesel engines, the spark plug is replaced by a fuel injector, and only air is compressed during the compression process.

Diesel Engine



- ▶ The Diesel cycle is the ideal cycle for CI reciprocating engines. The CI engine, first proposed by Rudolph Diesel in the 1890s
- ▶ In CI engines (also known as *diesel engines*), the air is compressed to a temperature that is above the autoignition temperature of the fuel, and combustion starts on contact as the fuel is injected into this hot air.

Compression Ratio for Diesel Cycle



Thermal efficiency of the ideal Diesel cycle as a function of compression and cutoff ratios ($k = 1.4$).

Thermal Efficiency of Diesel Cycle

$$\eta_{th,Diesel} = \frac{W_{net}}{q_{in}} = 1 - \frac{q_{out}}{q_{in}} = 1 - \frac{T_4 - T_1}{k(T_3 - T_2)} = 1 - \frac{T_1(T_4/T_1 - 1)}{kT_2(T_3/T_2 - 1)}$$

$$\eta_{th,Diesel} = 1 - \frac{1}{r^{k-1}} \left[\frac{r_c^k - 1}{k(r_c - 1)} \right]$$

1 2 3 4 5 6 7

Thank You

