Air-standard power cycles are idealized thermodynamic cycles used to model the performance of internal combustion engines, gas turbines, and other types of power-generating systems. These cycles assume that the working fluid (air) behaves as an ideal gas, undergoes reversible processes, and that no chemical reactions occur during the cycle. Here are the key air-standard power cycles:

## 1. Otto Cycle (Idealized Spark Ignition Engine Cycle)

- **Process Principle**: The Otto cycle is used to model gasoline engines. It consists of two adiabatic (isentropic) processes and two constant-volume processes. The cycle is broken down as:
    1. **Isentropic compression**: Air is compressed adiabatically.
    2. **Constant-volume heat addition**: Heat is added to the air at constant volume, representing the fuel combustion.
    3. **Isentropic expansion**: The air expands adiabatically, performing work.
    4. **Constant-volume heat rejection**: Heat is rejected at constant volume.
- **Applications**: Primarily used for gasoline engines in cars and motorcycles.

## 2. Diesel Cycle (Idealized Compression Ignition Engine Cycle)

- **Process Principle**: The Diesel cycle models the performance of diesel engines and consists of two adiabatic (isentropic) processes, one constant-pressure process, and one constant-volume process:
    1. **Isentropic compression**: The air is compressed adiabatically.
    2. **Constant-pressure heat addition**: Heat is added at constant pressure, representing the diesel fuel injection and combustion.
    3. **Isentropic expansion**: The air expands adiabatically, performing work.
    4. **Constant-volume heat rejection**: Heat is rejected at constant volume.
- **Applications**: Used in diesel engines, commonly found in trucks, buses, and some passenger cars.

## 3. Brayton Cycle (Idealized Gas Turbine Cycle)

- **Process Principle**: The Brayton cycle is used to describe the workings of gas turbines, especially in jet engines and power plants. It consists of:
    1. **Isentropic compression**: The air is compressed adiabatically.
    2. **Constant-pressure heat addition**: Heat is added at constant pressure, which corresponds to the combustion in the turbine.
    3. **Isentropic expansion**: The air expands adiabatically through a turbine, doing work.
    4. **Constant-pressure heat rejection**: Heat is rejected at constant pressure.
- **Applications**: Used in aircraft engines (jet engines), power generation plants, and industrial gas turbines.

## 4. Dual Cycle (Combination of Otto and Diesel Cycles)

- **Process Principle**: The dual cycle is a combination of the Otto and Diesel cycles. It has a mix of constant-volume and constant-pressure heat addition processes. This cycle is used to represent engines that have characteristics of both spark ignition and compression ignition engines. The processes are:
    1. **Isentropic compression**: Air is compressed adiabatically.
    2. **Constant-volume heat addition**: Initial heat is added at constant volume.
    3. **Constant-pressure heat addition**: Further heat is added at constant pressure.
    4. **Isentropic expansion**: The air expands adiabatically, performing work.
    5. **Constant-volume heat rejection**: Heat is rejected at constant volume.
- **Applications**: Models engines that exhibit both Otto and Diesel characteristics, often used in theoretical engine design.