Lesson

Understanding Principles of Operation of Internal Combustion Engines

Interest Approach

- Identify the different types of internal combustion engines used to power the machines.

Student Learning Objectives

- Define internal combustion engine and explain its principal parts.
- Describe the four events of the internal combustion engine.
- Explain the differences in operation of four-stroke and two-stroke internal combustion engines.
- Classify internal combustion engines.

Terms

- Compression
- Compression stroke
- Connecting rod
- Crankshaft
- Cycle
- Cylinder
- Diesel engines
- Engine block
- Engine displacement
- Exhaust
- Exhaust stroke
- Flat
- Four-stroke engine
- Gasoline Engines
- In-line

Terms (continued)

- Intake
- Intake stroke
- Internal combustion engine
- Large engines
- Multi-cylinder
- Piston
- Power
- Power stroke
- Reed valves
- Single-cylinder
- Small Engines
- Two-stroke engine
- Vee-block
- Wrist pin

Internal Combustion Engines

- A internal combustion engine is a device that converts the energy contained in fuel into rotating power
- Various parts are housed within an engine block

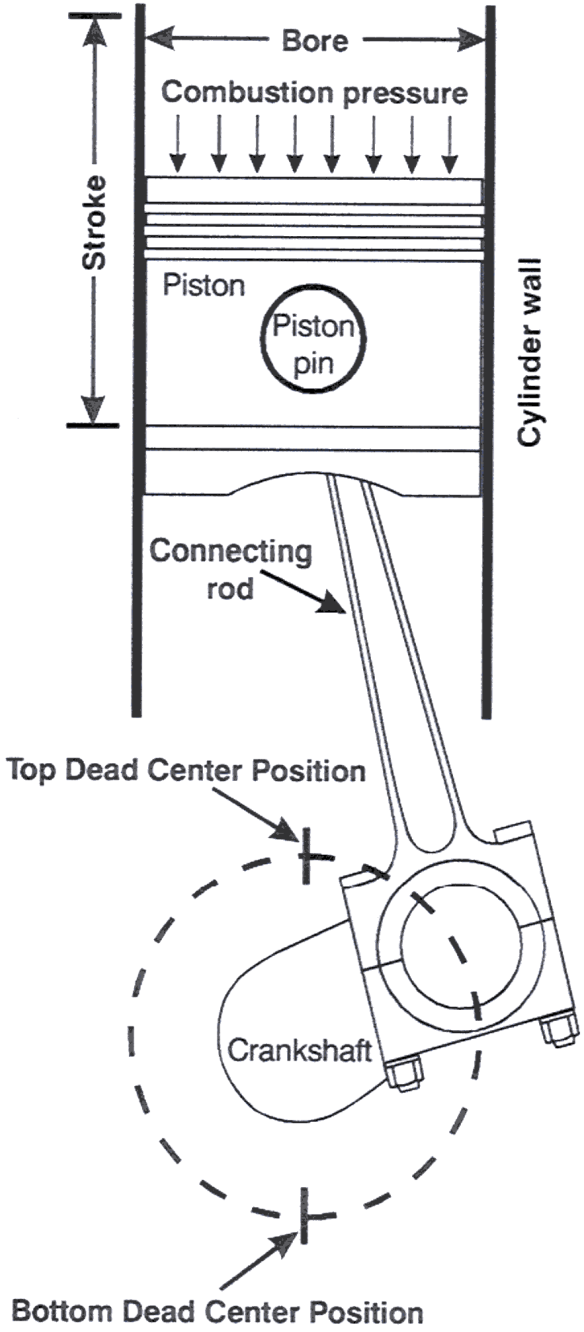
4 parts of the engine block

- 1) Cylinder – the part of the engine block where the combustion takes place.
  - Varies from 1 to 8
- 2) Piston – a plunger with rings that fit against the inside cylinder walls and prevent air from leaking past

4 parts of the engine block

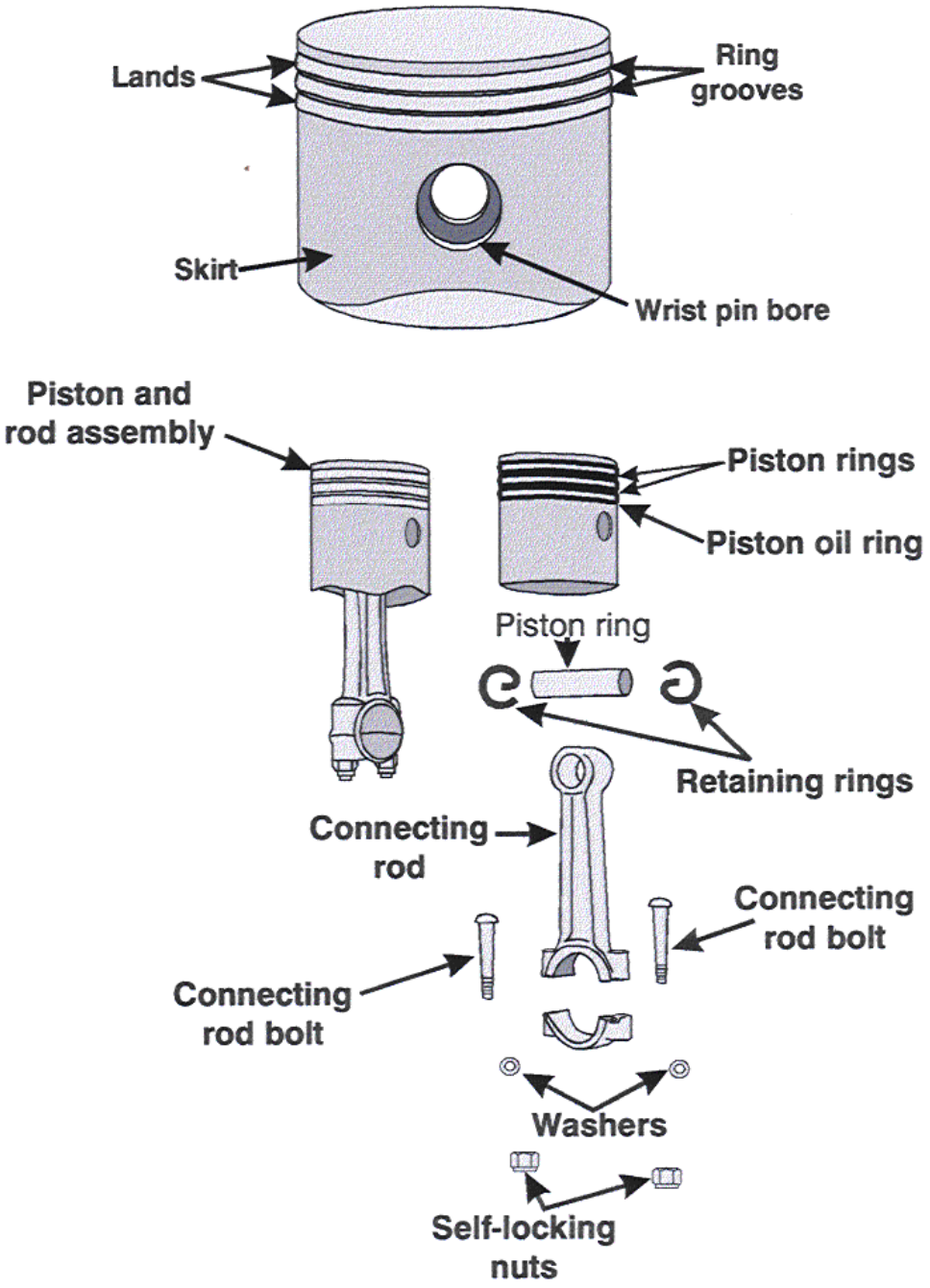
- 3) Connecting rod – connects the piston to the crankshaft.
  - Fastened by the wrist pin
- 4) Crankshaft – shaft with offsets to which the connecting rods are attached

Bore and stroke of a cylinder



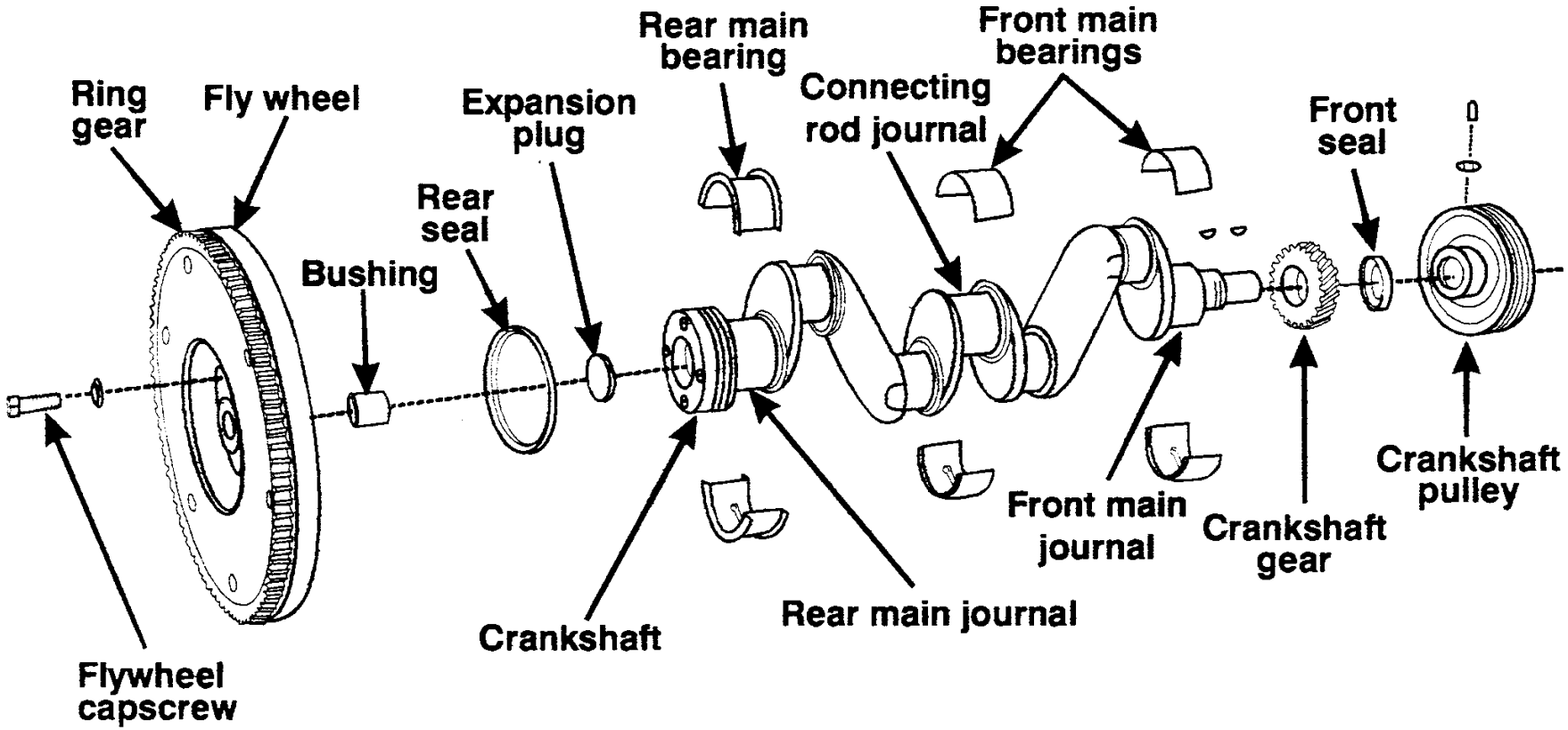
(Courtesy, Interstate Publishers, Inc.)

Piston and connecting rod



(Courtesy, Interstate Publishers, Inc.)

Crankshaft assembly



(Courtesy, Interstate Publishers, Inc.)

Internal Combustion Engine - Events

- The internal combustion engine operates based upon the principle of a cycle
  - A cycle is a series of events that are repeated over and over again
  - Four strokes make up a cycle: intake, compression, power, exhaust

Intake

- The process of getting the fuel and air required for combustion to take place in the chamber.
- Exhaust valve remains closed and intake valve is open

Compression

- The process of compressing the fuel-air mixture in the combustion chamber to increase the potential chemical energy of the heat from combustion.
- Intake and exhaust valves are closed.

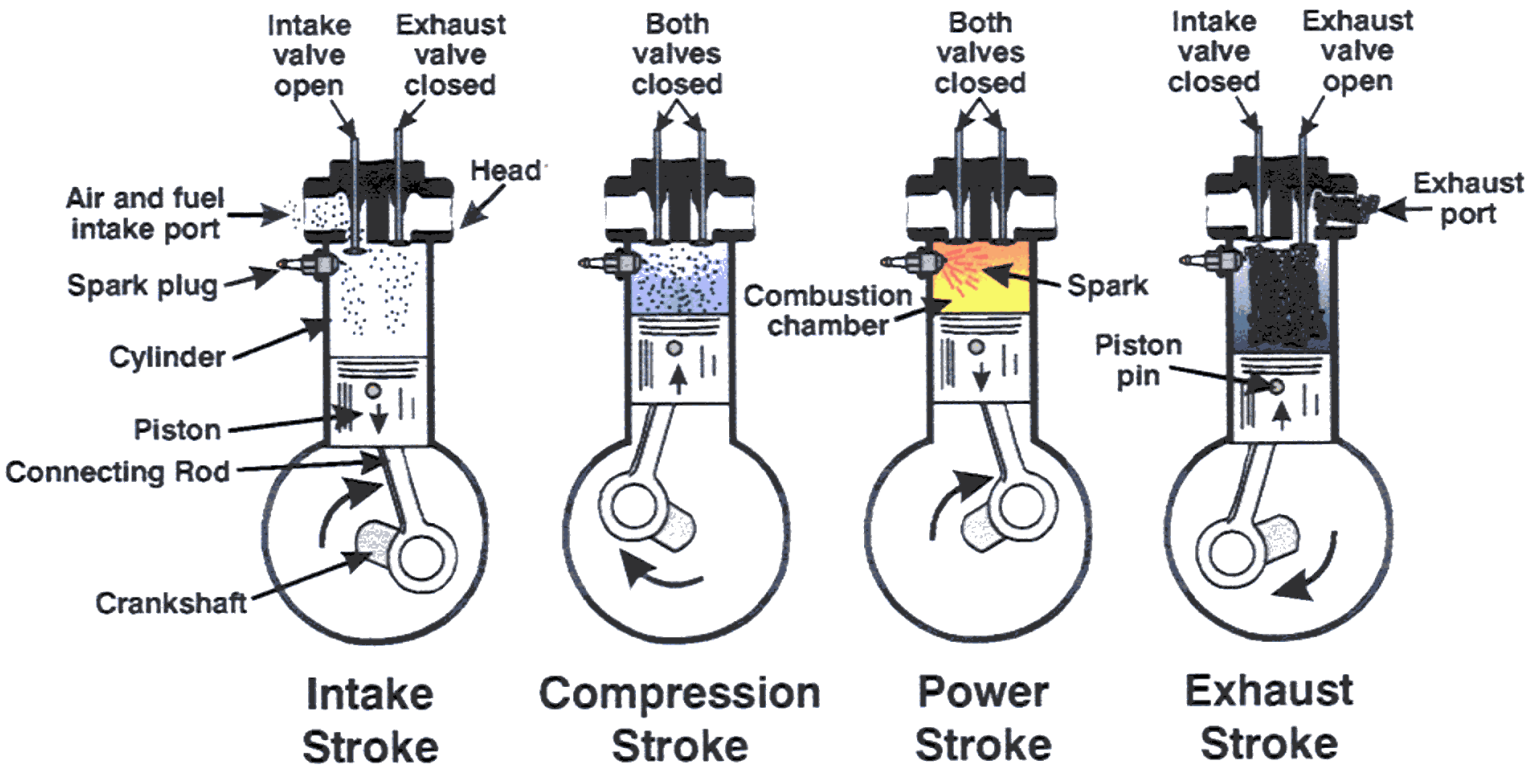
Power

- The result of converting the chemical potential energy to mechanical power by the rapid expansion of heated gasses.
- Gases produced by the combustion of the compressed fuel-air mixture in the combustion chamber.

Exhaust

- The process of removing the spent products resulting from combustion in the combustion chamber.
- Exhaust valves opens and spent gasses are forced from the cylinder.

Four-stroke cycle engine



(*Courtesy, Interstate Publishers, Inc.*)

Differences between four- and two-stroke engines

- A four-stroke engine has a series of four events that must be completed within the cycle.
- A two-stroke engine completes the same series of four events in two strokes.

Four-stroke engine

- 4 events completed in each stroke:
  - Intake
  - Compression
  - Power
  - Exhaust

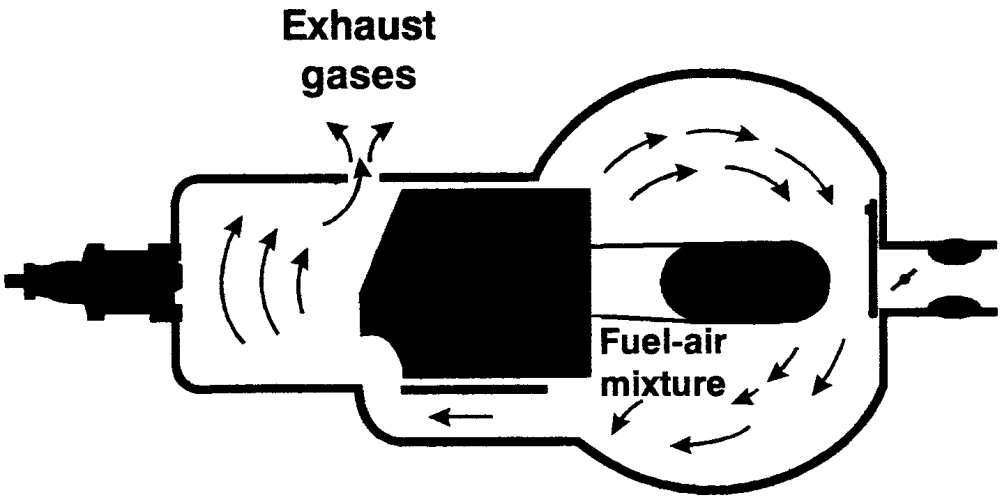
Two-stroke engine

- Completes the same four events in two strokes.
  - 1st stroke – release of exhaust gasses drives the piston downward.

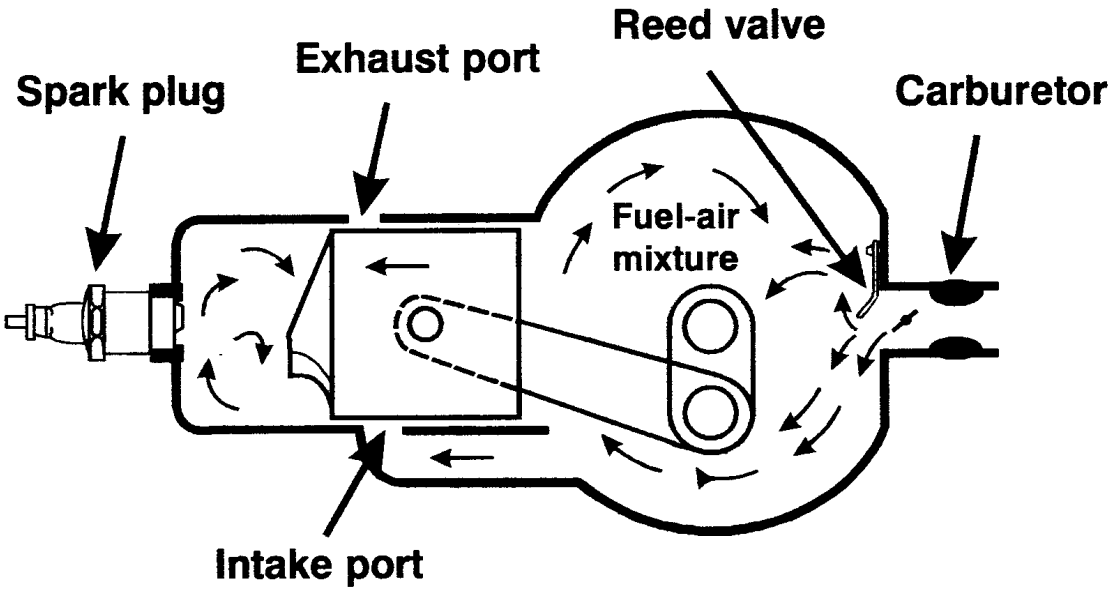
Two-stroke engine

- 2nd stroke – release of exhaust gasses drives the piston downward.
- Reed valves – one-way directional valves that allow the air-fuel mixture to enter the crankcase.

Two-stroke engine



First Stroke



Second Stroke

(Courtesy, Interstate Publishers, Inc.)

Classifying Internal Combustion Engines

- There are many ways by which internal combustion engines are classified
  - Piston strokes
  - Engine power
  - Number of cylinders
  - Engine displacement
  - Cylinder arrangement
  - Fuel ignition

Piston strokes

- Two-stroke
- Four-stroke

Engine power

- Small engines – produce less than 25 horsepower.
- Large engines – produce more than 25 horse power.

Number of cylinders

- Single-cylinder – engines have only one cylinder.
- Multi-cylinder – engines have 2, 3, 4, 5, 6, 8, or more cylinders.

Engine Displacement

- Describes the total swept volume of the engine cylinders as pistons complete one stroke.
- Expressed as either cubic inches or cubic centimeters.

Cylinder arrangement

- In-line – all of the cylinders are in a straight line.
- Vee-block – cylinders arranged in a “V” configuration.
- Flat – cylinder arrangements are perpendicular, or flat, in the relation to the earth.

Fuel ignition

- Gasoline engines – fuel-powered by a spark ignition.
- Diesel engines – use glow plugs and fuel in compression ignition.

Two-stroke Cycle Engines	Four-Stroke Cycle Engines
•Lighter weight •Operates in many positions •Higher power to weight ratio •Engine oil usually mixed with fuel •Louder operation •Higher Engine speeds •More vibration •Rough idling operation	•Heavier weight •Operates in limited positions •Lower power to weight ratio •Engine oil in a reservoir •Quieter operation •Slower engine speeds •Smoother operation •Smoother idling operation

Review/Summary

- What is an internal combustion engine? What are its principal parts?
- Describe the four events of the internal combustion engine.
- Explain the difference between four- and two-stroke internal combustion engines.
- How are internal combustion engines classified?