

Unit C: Agricultural Power Systems

Lesson 1: Understanding Principles of
Operation of 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 and parts

- ★ 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**

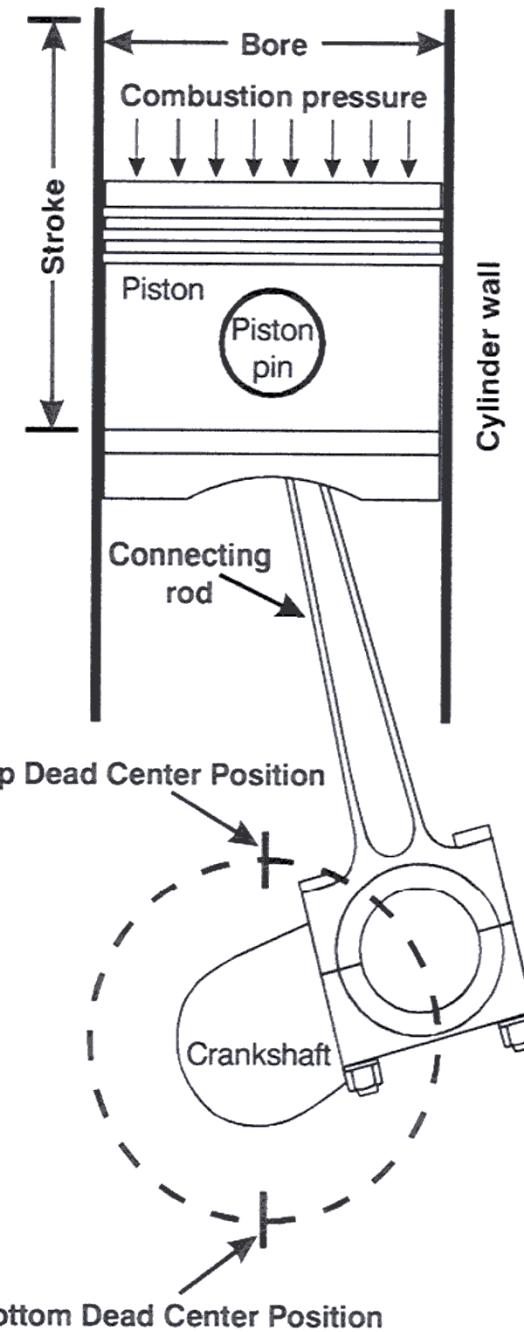
4 parts of the engine block

- ★ 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

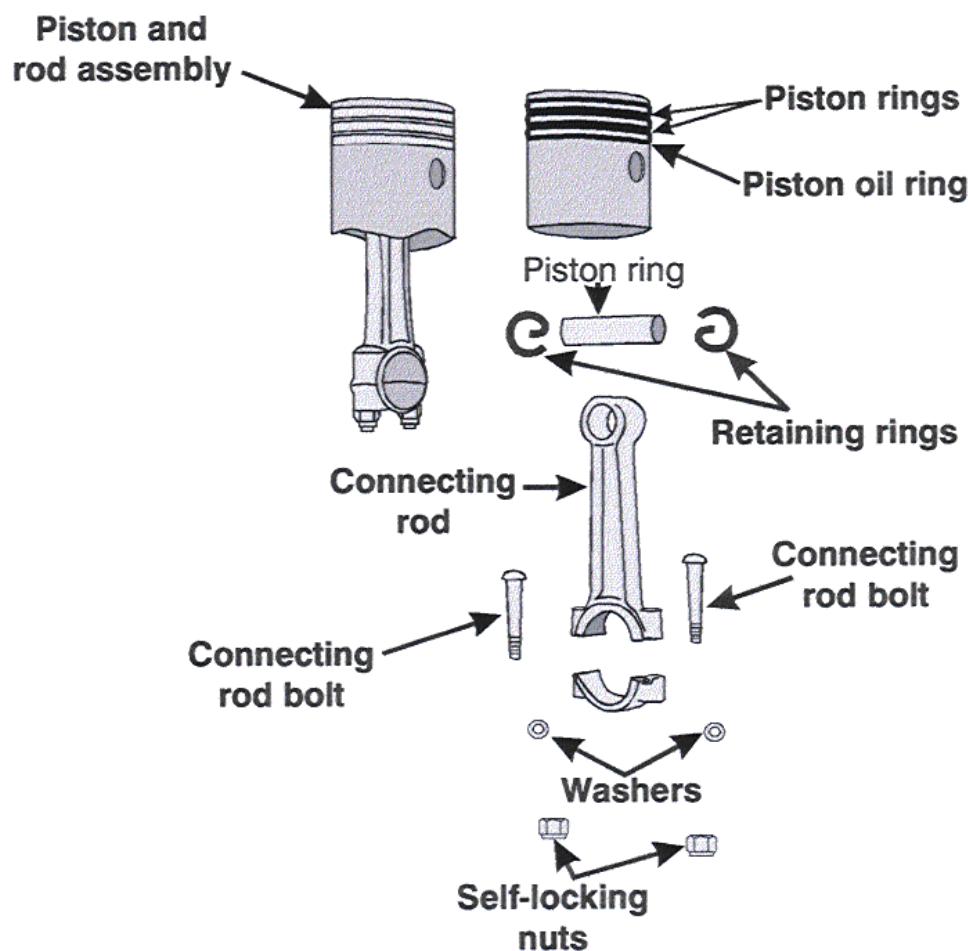
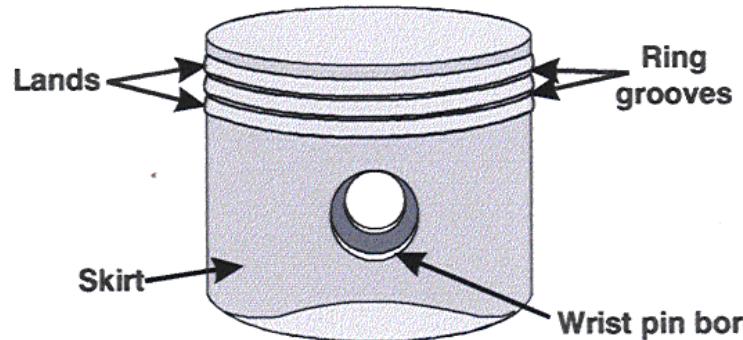
4 parts of the engine block

- ★ 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

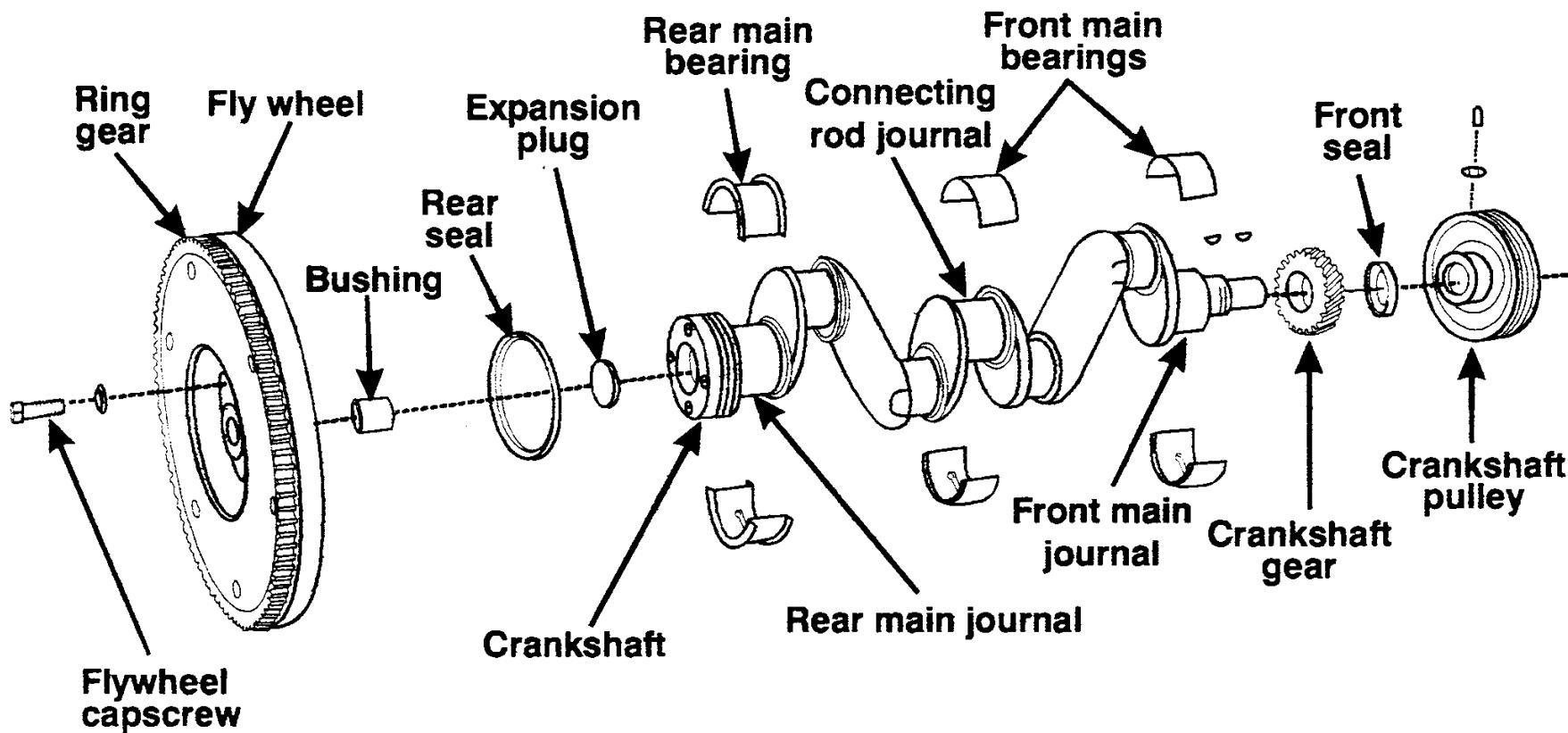
Bore and stroke of a cylinder



Piston and connecting rod



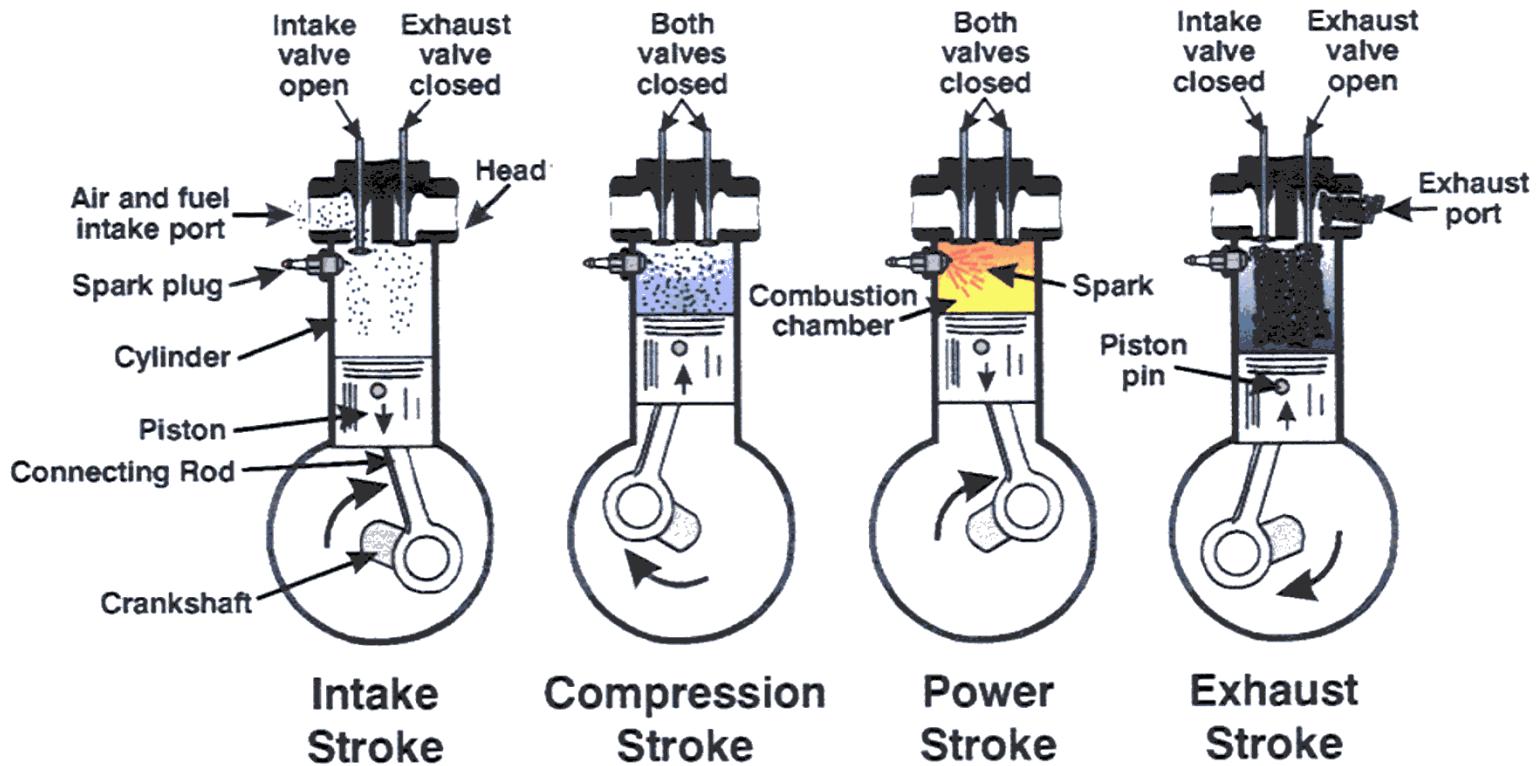
Crankshaft assembly



Events of the internal combustion engine

- ★ 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

Four-stroke cycle engine



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

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

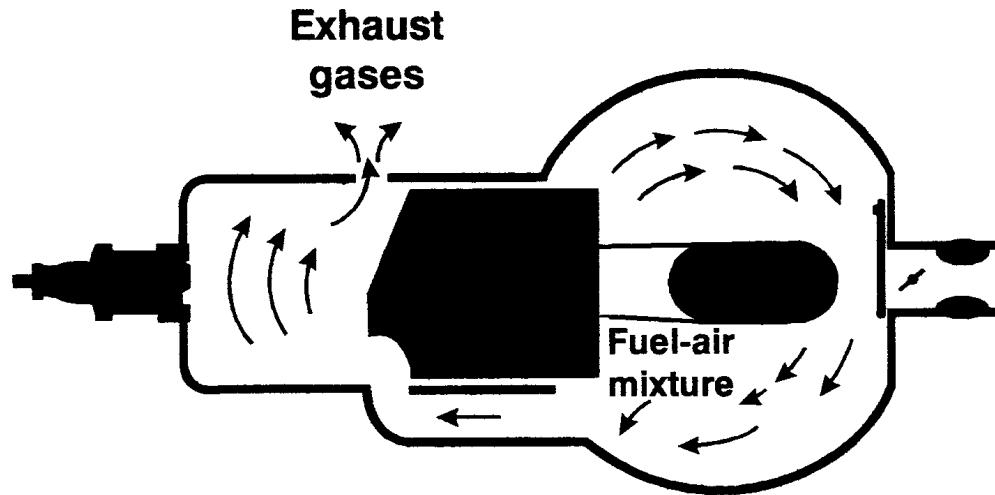
Two-stroke engine

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

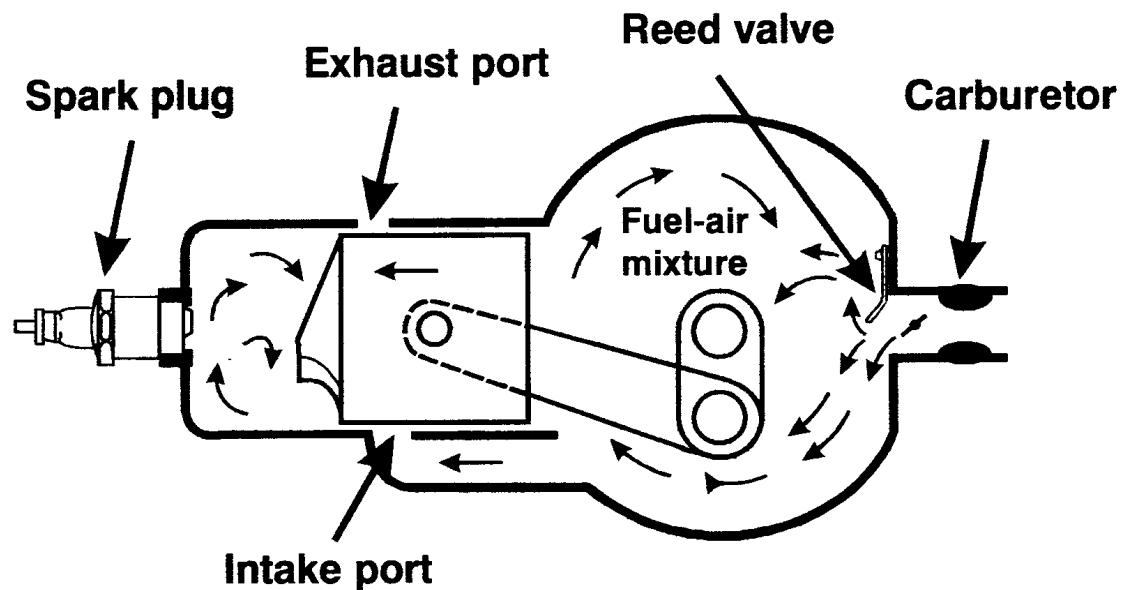
Two-stroke engine

- ◆ 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

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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

Characteristics of two- and four-stroke engines

Two-stroke Cycle Engines	Four-Stroke Cycle Engines
<ul style="list-style-type: none">•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	<ul style="list-style-type: none">•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

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

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?