

Unit C: Agricultural Power Systems

Lesson 1: Understanding Principles of Operation of Internal Combustion Engines

Terms

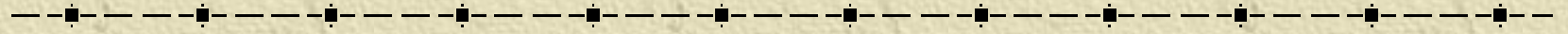
- ✦ Compression
- ✦ Compression stroke
- ✦ Connecting rod
- ✦ Crankshaft
- ✦ Cycle
- ✦ Cylinder
- ✦ Diesel engines
- ✦ Engine block

- ✦ 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**

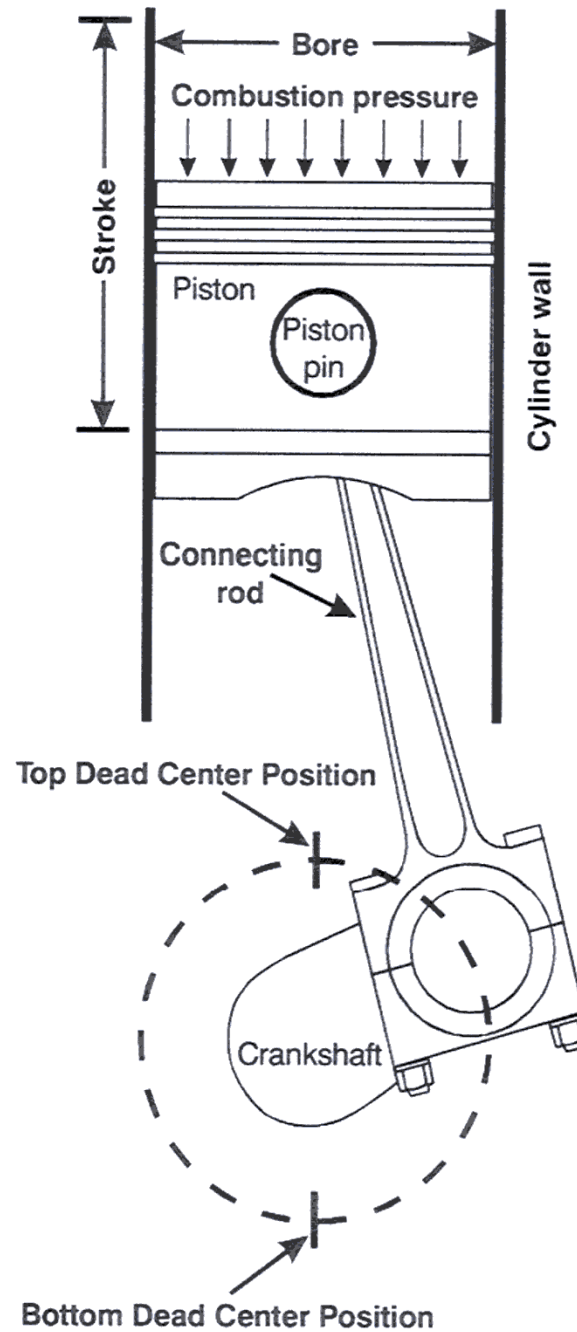
4 parts of the engine block

- ✦ 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

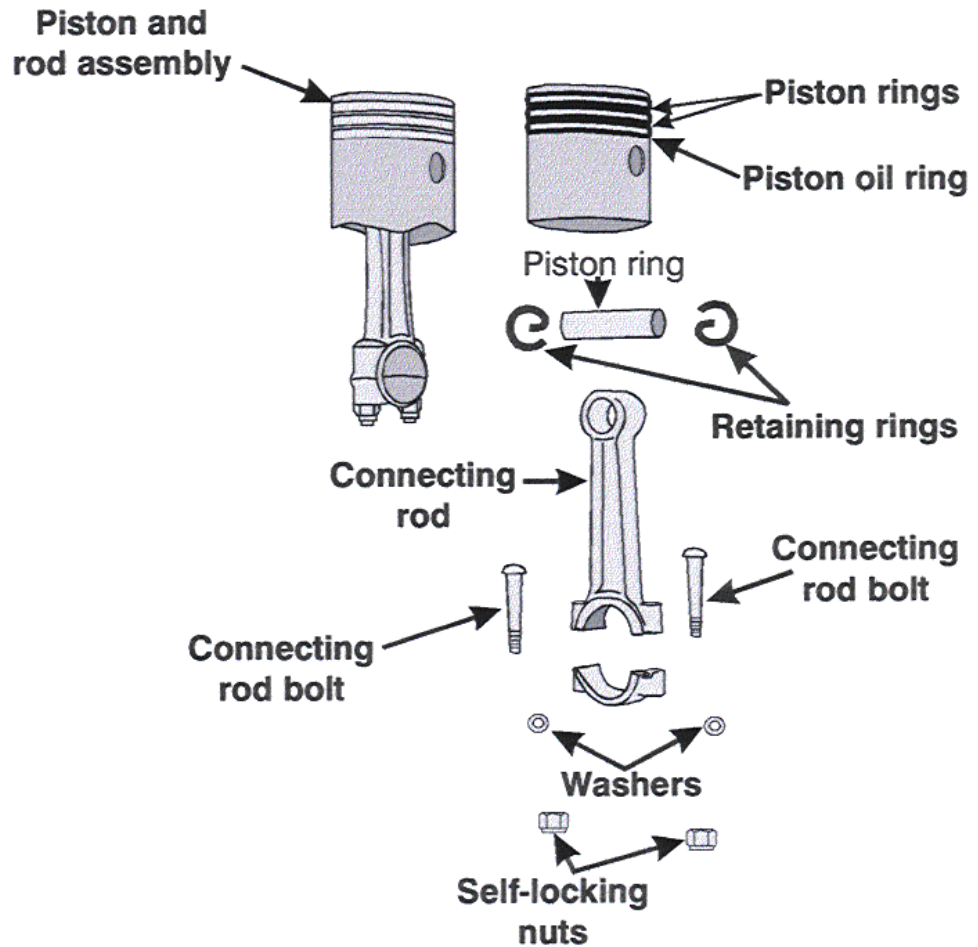
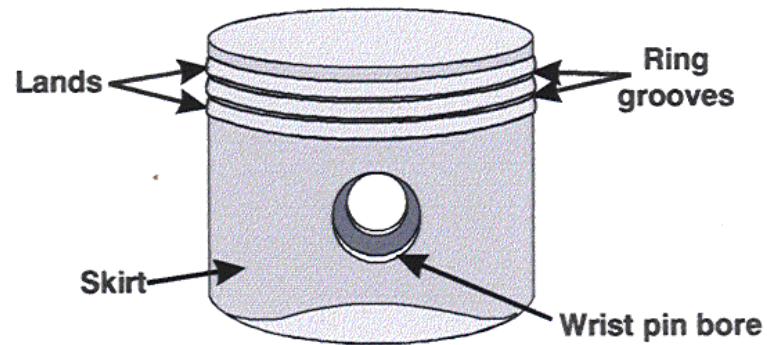
- ✦ 3) **Connecting rod** – connects the piston to the crankshaft. Fastened by the **wrist pin**
- ✦ 4) **Crankshaft** – shaft with offsets to which the connecting rods are attached

Bore and stroke of a cylinder

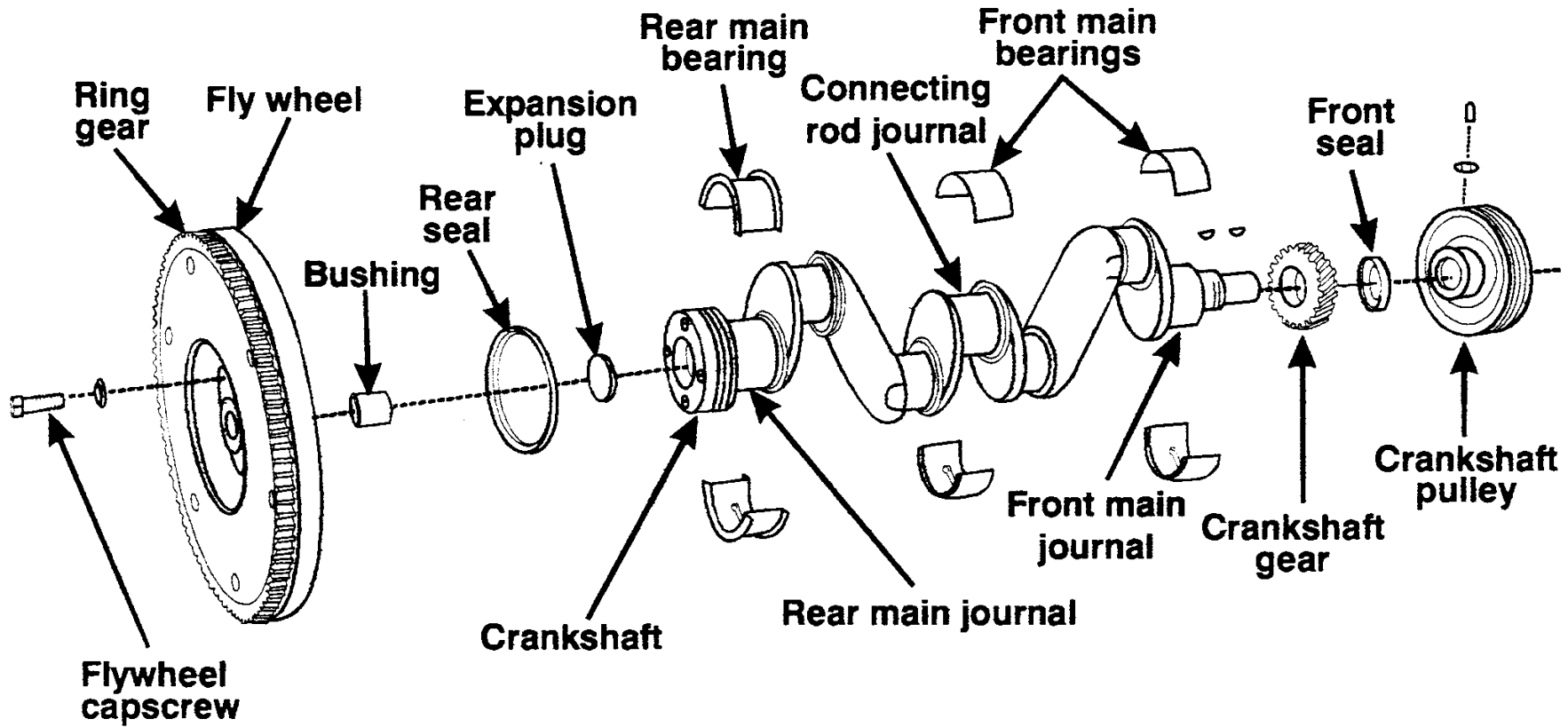


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Piston and connecting rod



Crankshaft assembly

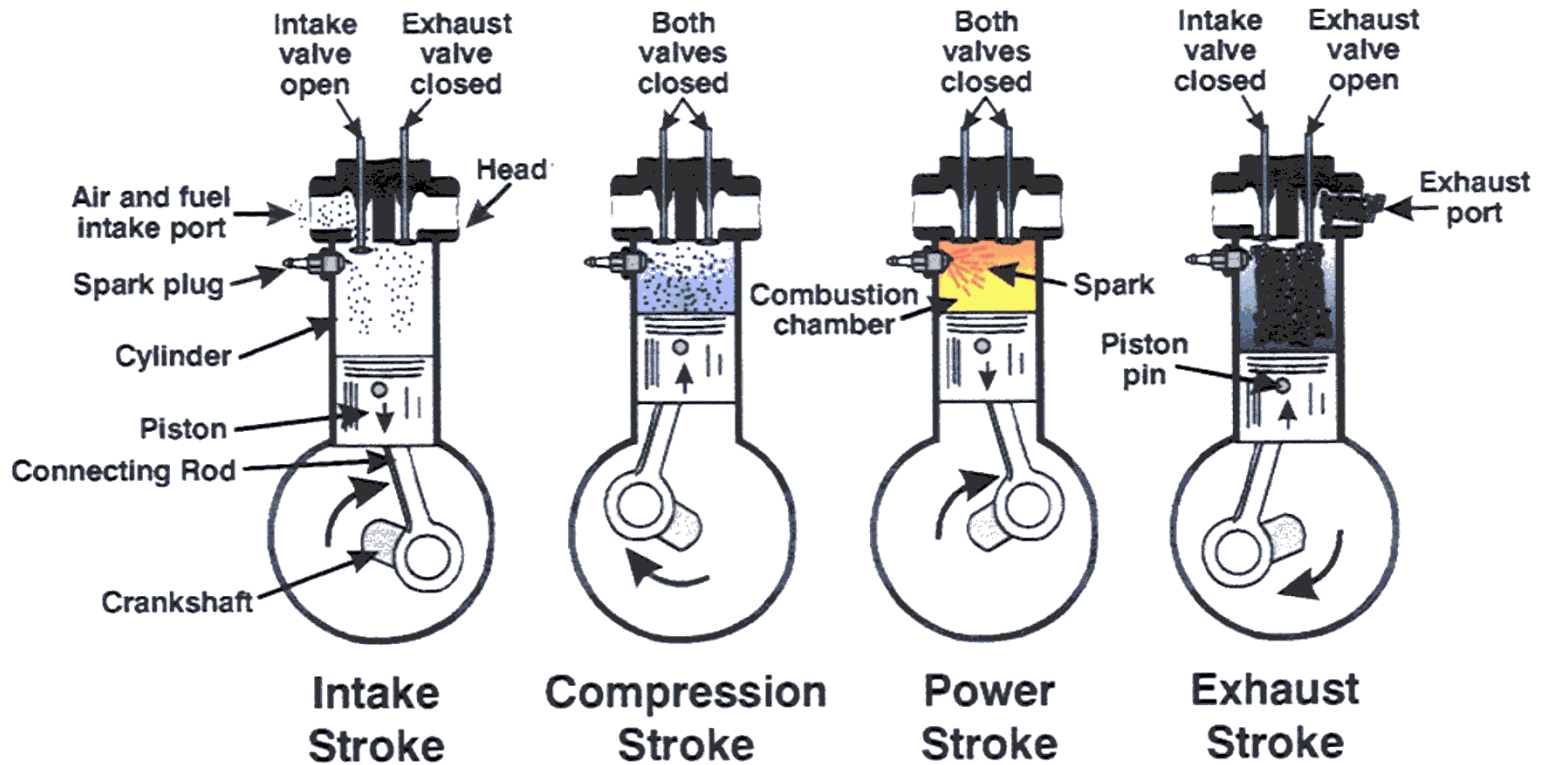


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Events of the internal combustion engine

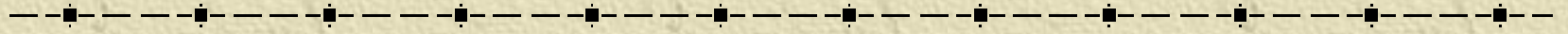
- ✦ The internal combustion engine operates based upon the principle of a cycle
- ✦ A **cycle** is a series of events that are repeated over and over again
- ✦ Four strokes make up a cycle: intake, compression, power, exhaust

Four-stroke cycle engine



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Intake

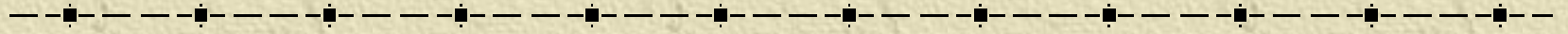


- ✦ The process of getting the fuel and air required for combustion to take place in the chamber
- ✦ Exhaust valve remains closed and intake valve is open

Compression

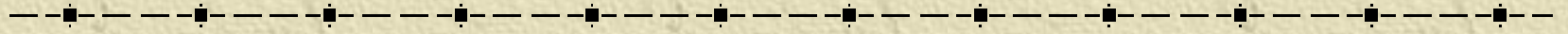
- ✦ The process of compressing the fuel-air mixture in the combustion chamber to increase the potential chemical energy of the heat from combustion
- ✦ Intake and exhaust valves are closed

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

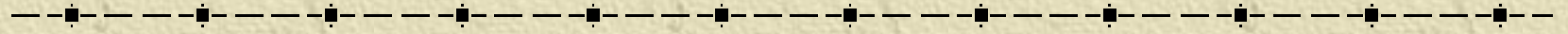


- ✦ The process of removing the spent products resulting from combustion in the combustion chamber
- ✦ Exhaust valves opens and spent gasses are forced from the cylinder

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

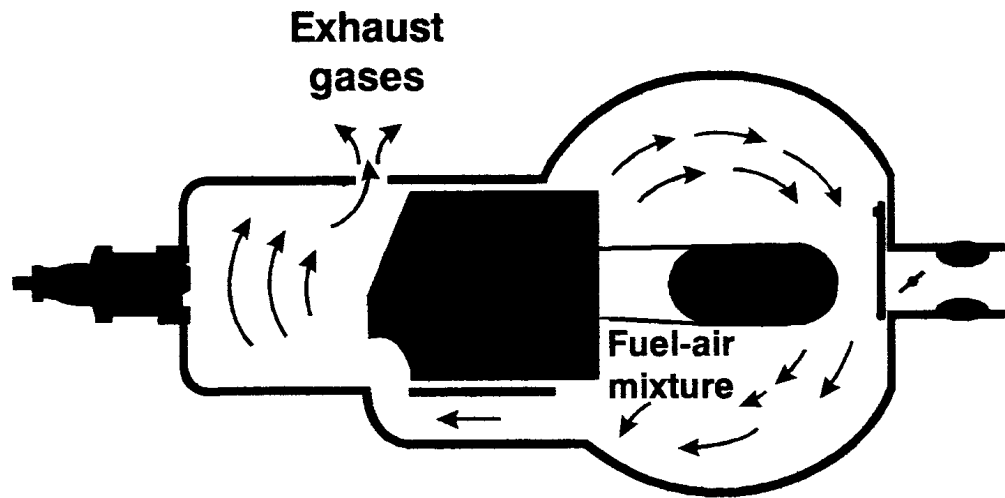
Two-stroke engine

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

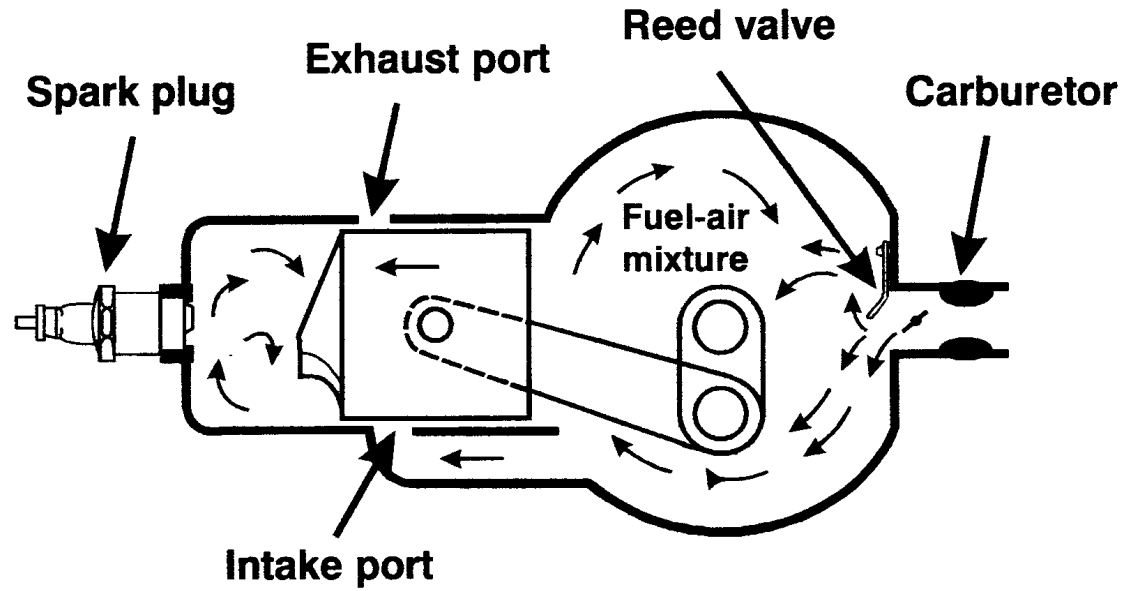
Two-stroke engine

- ◆ 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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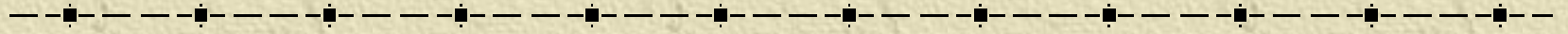
Classifying internal combustion engines

- ✦ 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

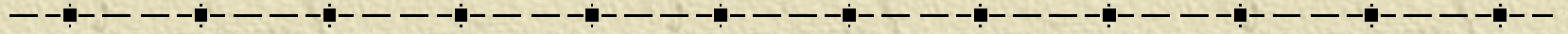
Engine displacement

- ✦ 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?