TYPES OF COMBUSTION ENGINES

There are three main types of piston engines in current use:

- Horizontally Opposed
- Radial
- In-Line

HORIZONTALLY OPPOSED

Two banks of cylinders that lie directly opposite to each other in the horizontal plane.

One crankshaft is driven by both rows.

Four, six, or eight cylinders.

Design is flat with small frontal area (good visibility) and low drag production.

Most commonly used in general aviation.

RADIAL

Cylinders arranged radially.

Always an odd number of cylinders.

Crankshaft is short, compact and light.

Produces tremendous horsepower.

Poor shape increases parasite drag and reduces forward visibility.

IN-LINE

Cylinders are arranged side by side in a row. Practical limit is six.

Any more cylinders and V, X or H type in-line engines are used.

Two crankshafts side by side.

Some are inverted for better visibility.

Little drag but heavier engine and size limited.

CONSTRUCTION OF A RECIPROCATING ENGINE

Piston	Cylinder shaped object that moves up and down.
Piston rings	Wrap around the piston and provide a seal between the piston and cylinder.
Connecting rod	Joins the piston to the crankshaft, which turns the propeller.

Cylinder head	Contains the inlet (intake) valve, exhaust valve and two spark plugs.
Camshaft	Turned by the crankshaft and operates the push rods and rocker arms. It turns at half the speed the crankshaft turns.
Magnetos	Provide electrical current to ignite the fuel/air mixture through the distributor.
Intake valve ports	Allow air to enter the cylinder and is connected to the carburetor where the air and fuel are mixed
Exhaust Valve	Connected to the exhaust pipe, which vents the exhaust fumes away from the cabin.

THE FOUR STROKE CYCLE

Most piston engines operate on the four stroke cycle. The piston moves through four strokes, two up and two down, to complete the cycle. The crankshaft makes two complete revolutions.

The four strokes are:

- the induction (or intake) stroke,
- the compression stroke,
- the power (or combustion) stroke, and
- the exhaust stroke.

INTAKE

Intake valve is open.

Piston moves down.

Fuel/air mixture drawn into combustion chamber through intake valve.

Exhaust valve remains closed.

COMPRESSION

Both valves are closed.

Piston moves up.

Mixture is compressed.

Compression ratio is comparison of volume of mixture with piston at the bottom and volume with piston at the top.

POWER

Both valves are closed.

Compressed mixture is ignited by spark plug.

Burning gas expands forcing piston down.

Energy drives other three strokes as well as useful work (i.e. turn propeller).

EXHAUST

Exhaust valve is open.

Piston moves up.

Burnt gas is pushed out through exhaust valve.

Intake valve remains closed.

TIMING

The purpose of timing is to improve the performance of the engine. Valves take time to open and close. Therefore they are timed to open early and close late in order not to waste any of the induction or exhaust stroke.

Valve lead:	timing the valve to open early.
Valve lag:	timing the valve to close late.
Valve overlap:	allowing both valves to remain open at the same time.

VALVE CLEARANCES

Valve clearances (or Tappet Clearance) is a space that must be provided between the valve stem and rocker to allow for heat expansion of the metal.

- Clearances too wide cause a loss of power and excessive wear.
- Clearances too close can warp the valves.