

1. IC Engine Nomenclature, 4S Petrol & Diesel Engines

06 February 2024 10:44

Engine: Device that transforms one form of energy to another

HEAT ENGINE

IC (Internal Combustion): combustion happens within the cylinder

EC (External Combustion): combustion happens outside cylinder; outdated

Transforms chemical energy to thermal energy and utilises this thermal energy to do useful work

Chemical \longrightarrow Thermal \longrightarrow Mechanical

IC ENGINE: NOMENCLATURE

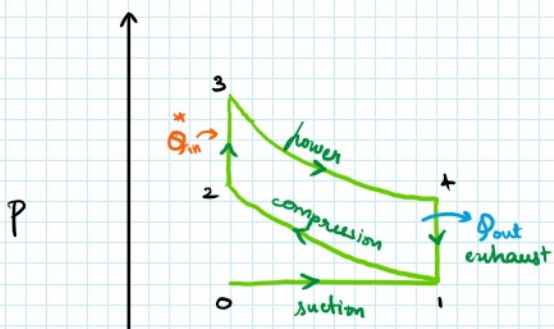
- Cylinder bore (d): Nominal inner diameter of working cylinder
- Piston Area (A): Area of a circle w/ diameter equal to cylinder bore (d)
- Stroke (L): Nominal distance through which the piston moves between TDC and BDC
- Top Dead Centre (TDC):
- Swept Volume / Displacement Volume:

$$V_s = A \times L = \frac{\pi}{4} d^2 L$$

- Clearance Volume: Empty space above TDC: allowance given to avoid damage
- Compression Ratio (r): Ratio of the total cylinder volume when the piston is at BDC to clearance volume

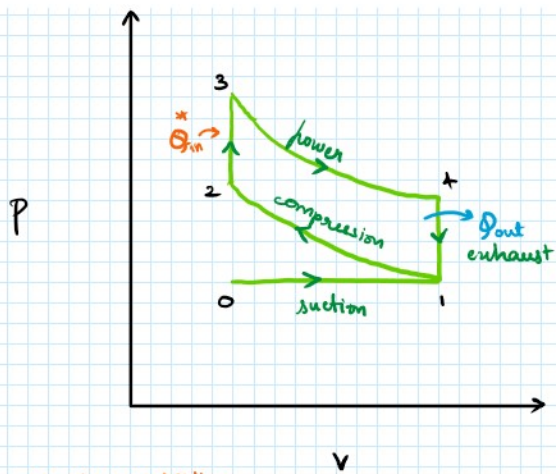
$$r = \frac{V_T}{V_c} = \frac{V_c + V_s}{V_c} = 1 + \frac{V_s}{V_c}$$

WORKING PRINCIPLE OF 4 STROKE PETROL ENGINE



Cycle of operation of ideal 4S engine has:

- ① suction/intake stroke
- ② compression stroke
- ③ expansion/power stroke
- ④ exhaust stroke

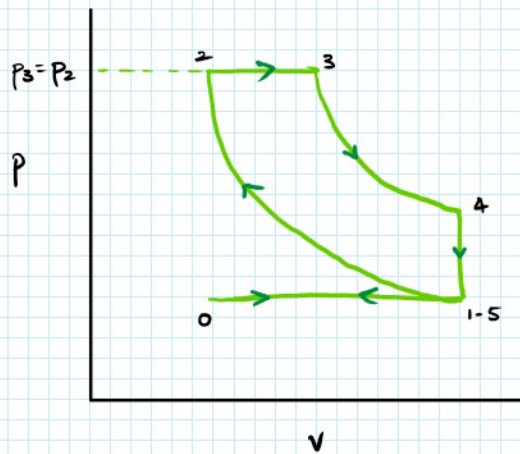


cycle of operation of Otto cycle engine

- ① suction/intake stroke
- ② compression stroke
- ③ expansion/power stroke
- ④ exhaust stroke

* - heat addition
spark plug action
happens at constant volume - isochoric process

WORKING OF 4S DIESEL ENGINE (COMPRESSION IGNITION)



PETROL & DIESEL 4S ENGINES: COMPARISON

DESCRIPTION	PETROL (STROKE IGNITION)	DIESEL (COMPRESSION IGNITION)
Basic cycle	Works on Otto cycle / constant volume heat addition / isochoric	Works on Diesel cycle / constant pressure heat addition / isobaric
Fuel	Petrol \rightarrow highly volatile Self ignition temperature is high	Diesel \rightarrow non-volatile Self ignition temp is low
Introduction of fuel	Gaseous mixture of fuel-air is introduced in suction stroke. Carburettor and ignition system are necessary.	Fuel is injected directly into combustion chamber at high pressure at the end of compression stroke. Fuel pump and injector are necessary.
Ignition	Requires ignition system w/ spark plug	Self ignition due to high temperature of air which is due to high compression
Compression ratio (CR)	6 to 10. Upper limit fixed by antiknocking quality of fuel	16 to 20. Upper limit is fixed by weight increase of engine.
Speed	Light weight \rightarrow higher speed	Heavy weight \rightarrow low speed
Thermal efficiency	Lower CR \rightarrow Max. value of thermal efficiency is lower	Higher CR \rightarrow Max value of thermal efficiency is higher
Weight	Lighter \rightarrow comparatively lower peak pressure	Heavier \rightarrow comparatively higher peak pressures

CLASSIFICATION OF IC ENGINES

Factors:

- No. of strokes / cycle
- Nature of thermodynamic cycle
- Ignition systems
- Fuel used
- Arrangement of cylinders
- Cooling systems
- Fuel supply systems

BASIC STRUCTURE OF IC ENGINE