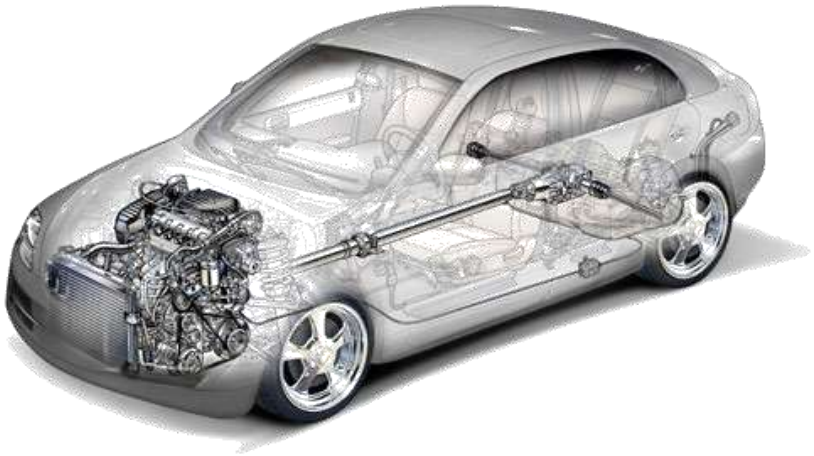
2

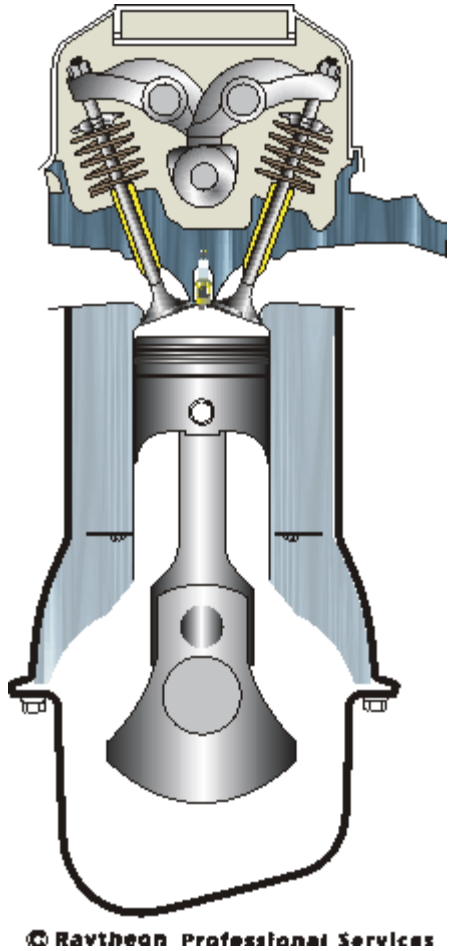
Engine & Engine Systems



Petrol Engine Operation

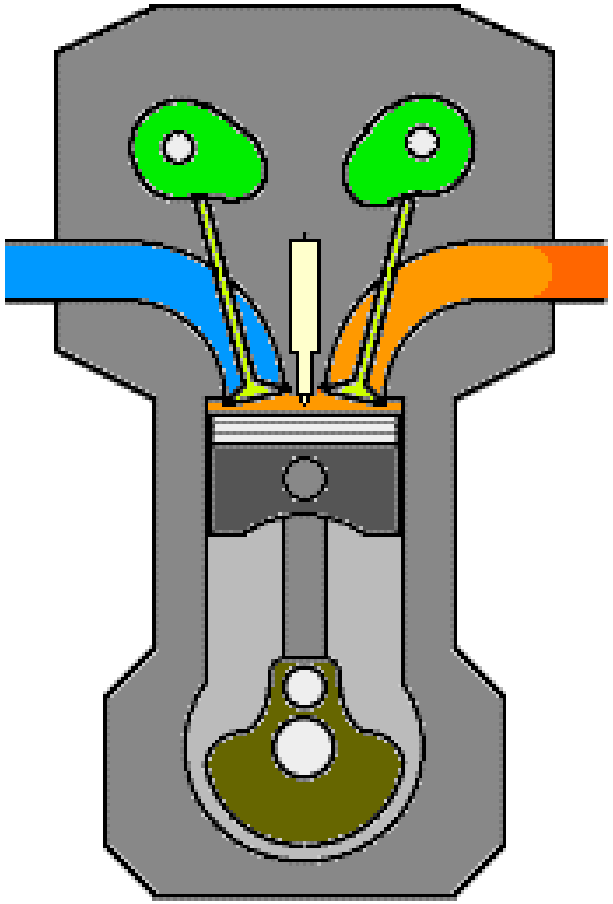
- ***Stroke 1 (Intake)*** – air & fuel mixture enters cylinder
- ***Stroke 2 (Compression)*** – air & fuel mixture is compressed
- ***Stroke 3 (Power)*** – spark plug fires, ignites fuel.
- ***Stroke 4 (Exhaust)*** – burnt gases are expelled from the engine

- Power is generated only during the power stroke
- Process of 4 strokes is repeated to keep engine running.



Diesel Engine Operation

- ***Stroke 1 (intake)*** – only air enters cylinder.
- ***Stroke 2 (compression)*** – air is compressed to high extent, raising its temperature.
- ***Stroke 3 (power)*** – diesel is injected, high air temperature ignites diesel.
- *S**troke 4 (exhaust)*** – burnt gases are expelled from the engine.



Differences in Operations

Petrol

- ***Stroke 1 (intake)*** – air & fuel mixture enters cylinder
- ***Stroke 2 (compression)*** – air & fuel mixture is compressed
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- ***Stroke 4 (exhaust)*** – burnt gases are expelled from the engine

Diesel

- ***Stroke 1 (intake)*** – only air enters cylinder.
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- ***Stroke 3 (power)*** – diesel is injected, high air temperature ignites diesel.
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Engine And Engine Basics

COMPRESSION RATIO:

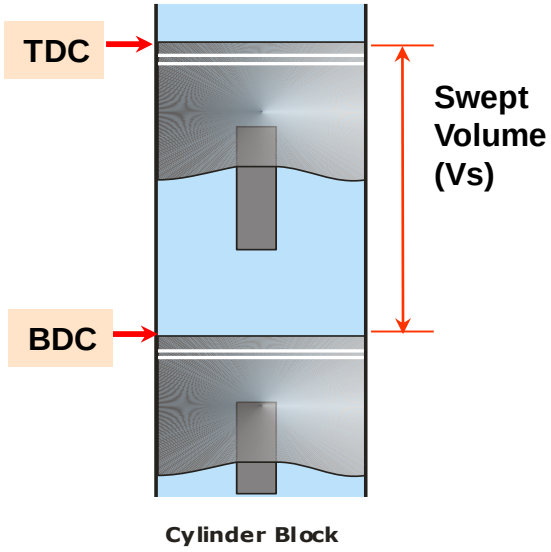
Compression Ratio compares the volume of air in Cylinder before Compression with volume of air after compression .

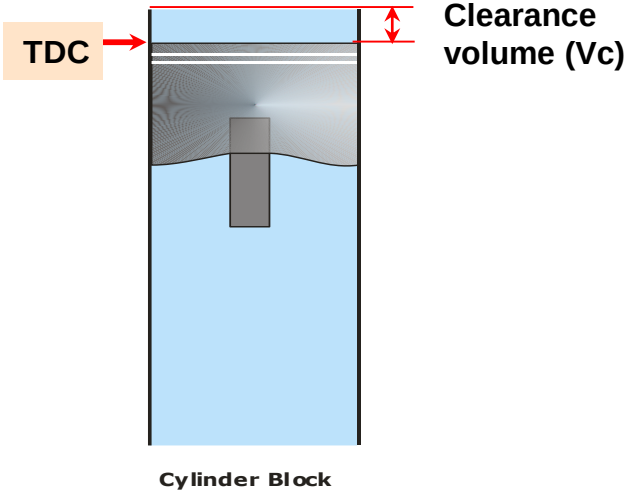
$$\frac{Vs + Vc}{Vc} = \text{COMPRESSION RATIO}$$

Vs = Volume between T.D.C TO B.D.C position.

Vc = Volume above the piston when it is in the T.D.C position

Compression Ratio
for petrol Engine : 8 ~ 10
for Diesel Engine : 15 ~ 24





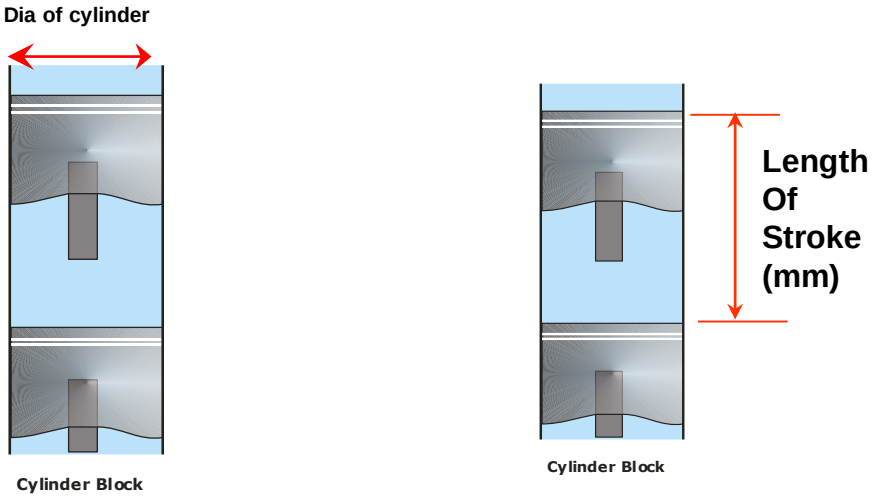
Engine And Engine Basics

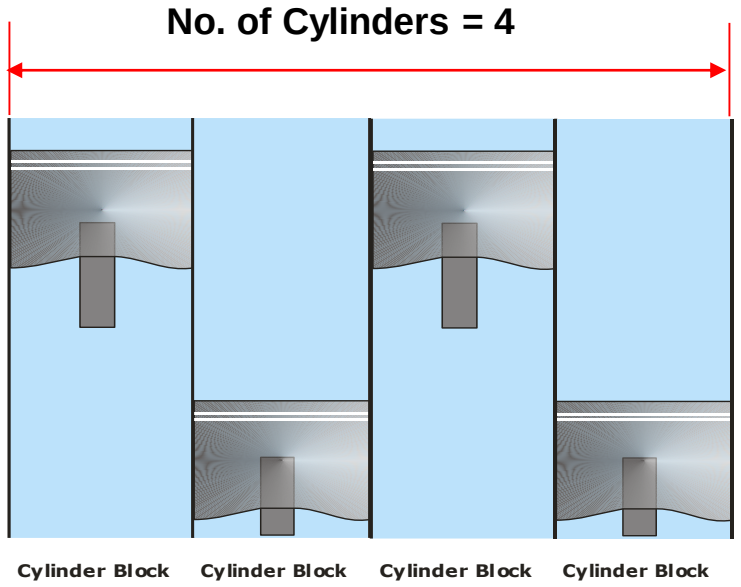
SIZE OF ENGINE (CC)=

Dia. of Cylinder x length of stroke X Number of Cylinders

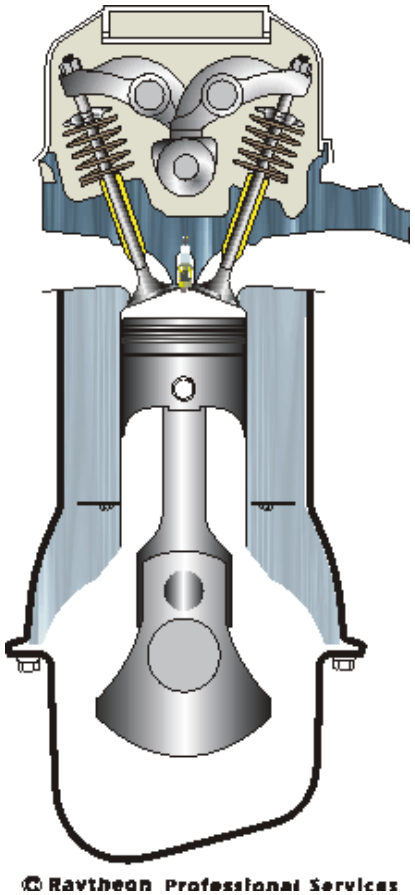
Measurement taken in cubic centimeters (cc),

1000cc = 1 liter (litre)
e.g.
1800cc engine = 1.8 Liter
Higher cc of engine, results in higher amount of power generation.



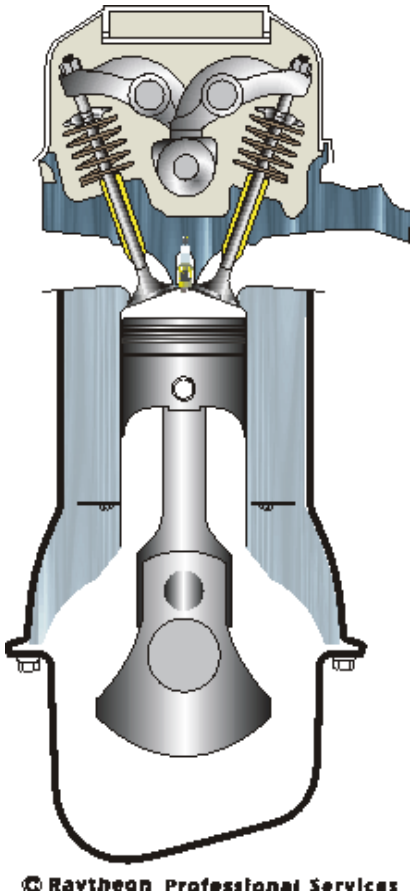


No. of Valves



- Valves are provided in the engine to “breathe” (to take in air & fuel and to let out exhaust gases).
- We know that at least 2 valves are required in each cylinder of engine.
- One for intake and other one for exhaust.

No. of Valves



- However it is possible to have more than 2 valves in each cylinder such as 3 or 4
- In 3 valves cylinder 2 valves are for intake and 1 for exhaust.
- In 4 valves cylinder 2 valves are for intake and 2 for exhaust

Why More No. of Valves

- Try to breathe through one nostril and then through both.
- Did you notice the difference. Yes it was hard to breathe through only one nostril.
- Similarly more number of valves helps engine to breathe easily

Camshaft Arrangements

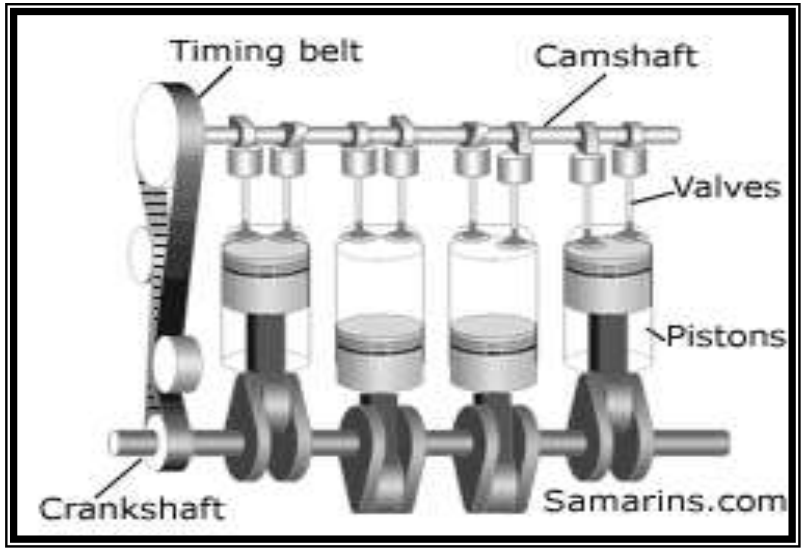
Camshaft:

The part of engine which opens and closes the valves is called Camshaft.

The layout of camshaft and valves in the engine is called camshaft arrangement.

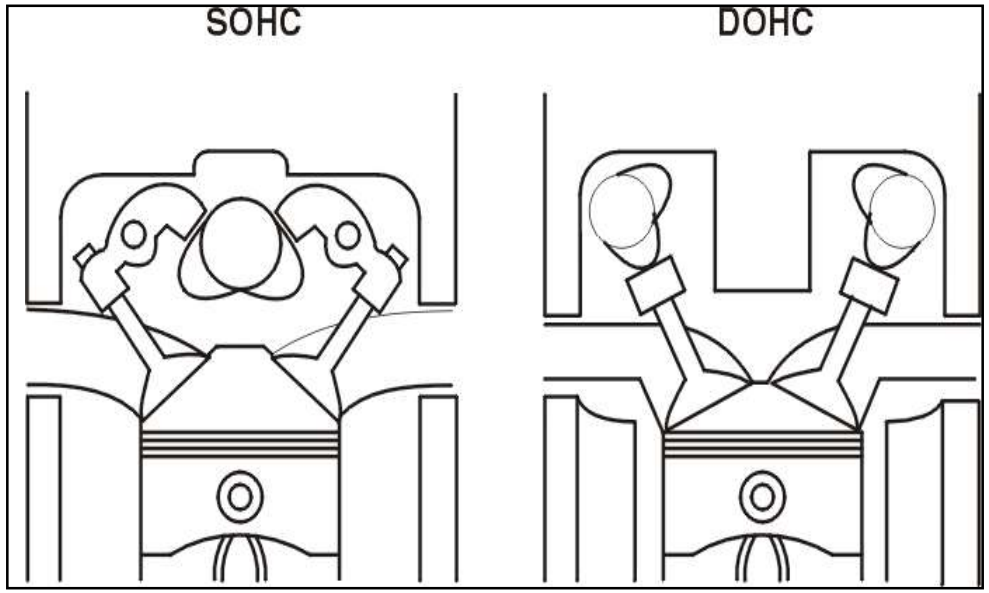
There are different types of Valve and Camshaft arrangement in engines depending on shape, size and use of engine.

Single Over Head Camshaft (SOHC)



- Here, all inlet and exhaust valves are operated by one camshaft directly that is located above the cylinder block.
- This type of arrangements is superior to the older arrangement operating the valve through push rods.

Dual Over Head Camshafts (DOHC)



- These engines have two camshafts over the engine head. One to operate the intake valves and the other to operate the exhaust valves.
- This *generally* makes the operation move *precise* and thus it is easier for the car to give *better performance & efficiency*

Dual Over Head Camshafts (DOHC)

DOHC features & benefits

- Two camshafts placed on cylinder head
- Faster valve response (better control on valve timing)
- Engine operates efficiently at high speed too
- Efficient combustion
- More powerful engine

Engine Performance

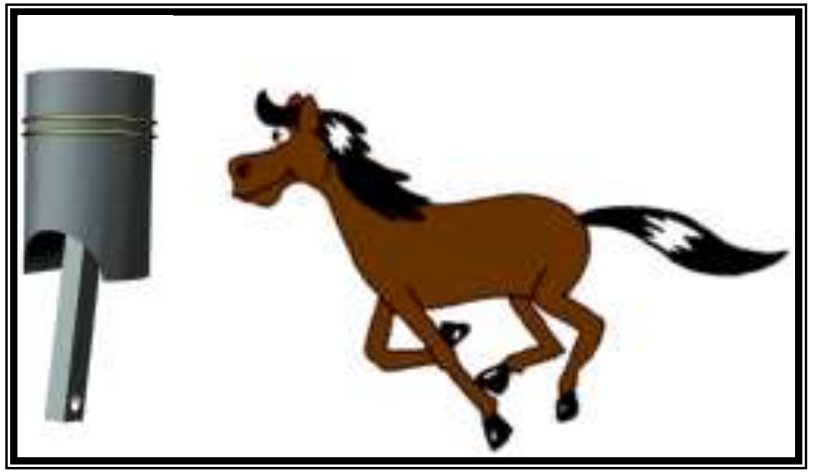
Engine performance is presented by various manufacturers using the following terms:

- Power - BHP/ PS
- Torque

Engine – Power (BHP)

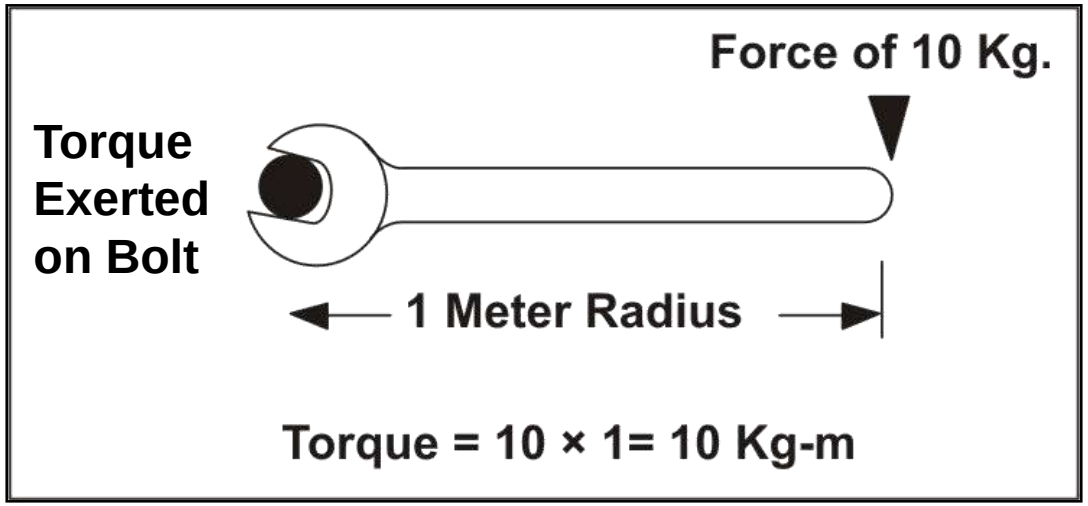
- Power – Work done per unit time.
- BHP (Brake Horse Power) is unit of measuring engine power.
- Depends on its torque and engine speed (RPM).
- Engine Power = Torque X RPM
- The higher the BHP, the more powerful an engine is.
- Conversion BHP to Kw : - Multiply By 0.7457
- Conversion Kw to BHP : - Multiply By 1.341

Engine – Power (PS)



- PS (***Pferdestärke = Horse Strength***) is a German term for Horse Power
- 1 PS = 0.9863 bhp
- In Indian Market all the manufacturers use unit of PS or Brake Horsepower to indicate engine power.

Torque



- A twisting force is defined as torque.
- Torque = Force X Radial Distance
- Measured in Kilogram-meter (Kg-m) or Newton-meter (N-m).
- Conversion Kg-m to Nm : - Multiply By 9.80665
- Conversion Nm to Kg-m : - Multiply By 0.1019716

High Torque at Low RPM

Advantages & Benefits

- Faster pick up
- Lesser gear shifts
- Enhanced fuel economy
- Longer engine life
- Lesser maintenance costs

Power To Weight Ratio

$$\text{Power-to-weight ratio} = \frac{\text{power generated}}{\text{Weight Of The Vehicle}}$$

- A higher figure indicates more power for a given weight.

- More power for a given weight leads to better pick up & better fuel economy (Keeping all other variables constant**)