

# Evolution towards Six Stroke Engine

Vishal Pal

Department of Automobile Engineering, PDM College of Technology and Management,  
(Affiliated to Maharishi Dayanand University), Bahadurgarh, Haryana

**Abstract:** In the generation high speed, high performance and efficient engine, there is necessity to increase thermal efficiency of engine which is the most difficult technique in engine. Modern four stroke IC engine is adopted widely due to its excellent power to weight ratio and reliability whereas; they have very low thermal efficiency as large amount of energy is lost through exhaust and cooling of engine, also less torque is generated and pollution is more. Six stroke engine is similar to IC engine but has high thermal efficiency and better scavenging, also have increased efficiency by 40% and reduction in pollution because of adaptability of multi-fuel. Six stroke engine have additional power stroke hence twice power is generated in comparison to 4 stroke engine and difference in 4 & Six stroke engine is of the thermodynamic cycle modified cylinder head with 2 supplementary chambers. As the time passes availability of the crude oil will decrease so, Automotive industry might soon be revolutionized by new Six stroke engine as it is highly fuel efficient, less polluting and would increase world economy. This paper discusses the concepts, features, changes need to be made in crankshaft for six stroke engine and comparative discussion is done.

**Keywords:** Six stroke engine

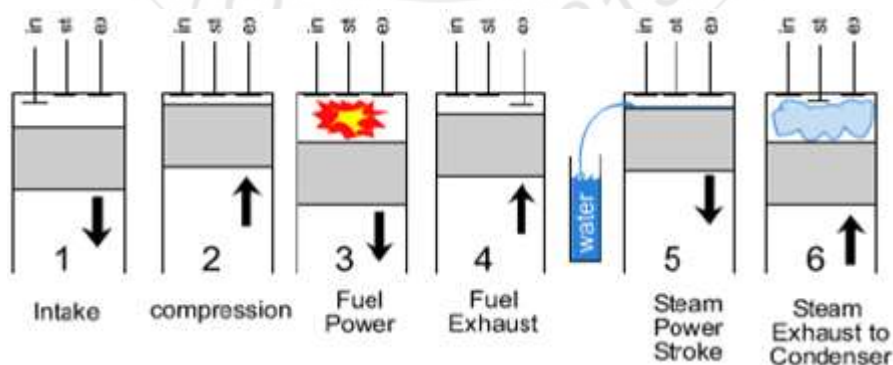
## 1. Introduction

Six stroke engine is a type of internal combustion (IC) engine which generates more power and is more fuel efficient than widely adopted 4 stroke engine. It is similar to 4 stroke engine with additional 2 valves and modified supplementary cylinder head with 2 supplementary chambers. Six stroke engine working is similar to 4 stroke engine with additional 5th (power/expansion) and 6th (exhaust) stroke.

## 2. Working of Six Stroke Engine

- 1st (suction/induction) stroke: - Initially the piston is at Top Dead Center (TDC) and ends at Bottom Dead Center (BDC). In this stroke Inlet valves opens and air- fuel mixture is sucked into the cylinder producing vacuum into the cylinder.

- 2nd (compression) stroke: - Stroke begins at BDC and ends at TDC. In this stroke the piston compresses the air-fuel mixture for the ignition in power stroke. Intake and exhaust valves are closed during this stroke.
- 3rd (1st power/combustion/ignition) stroke: - in this stroke the crankshaft has completed 360 degree. The piston is at TDC and forcibly returns to BDC by ignition of air-fuel mixture hence producing power for mechanical work.
- 4th (1st exhaust) stroke: - piston moves from BDC to TDC and The exhaust valve open removing the exhaust gases.
- 5th (2nd power) stroke: - piston moves from TDC to BDC and the water Inlet valves open. Fresh water from the water Inlet valves enters the cylinders through the secondary water Induction system.
- 6th (2nd exhaust) stroke: - The water exhaust valves remain open. The water sucked into the cylinder during the 5th stroke is removed to the atmosphere through the water exhaust valve. Piston moves from BDC to TDC and six strokes are completed.



## 3. Engine Modification

To make conventional six stroke engine work smoothly, easily and successfully, some modifications has to be done with some parts of 4 stroke engine.

### Crankshaft to camshaft ratio modification

Originally the angular speed ratio of crankshaft to camshaft is 2:1 i.e. when crankshaft makes 2 revolution camshaft

completes 1 revolution. 4 stroke engine crankshaft have 21 tooth and camshaft have 42 tooth also, crankshaft makes 720 degree rotation while camshaft rotates 360 degree to complete cycle. For the Six stroke engine working, crankshaft must rotate 1080 degree and camshaft by 360 degree to complete one cycle due to which speed ratio comes out to be 3:1. The camshaft should have 42 teeth similar to 4 stroke engine while crankshaft should have 14

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tooth i.e. in 3:1 ratio. Hence it's necessary to keep camshaft pulley 3 times bigger than crankshaft.



**Camshaft modification**

The cam's 360 degree is divided into 60 degree each in six stroke engine. The piston moves 3 times up & down.

There are 2 exhaust stroke; one at the time of 4th stroke when hot & burnt gases moves out and one at Sixth stroke which pushes steam out.

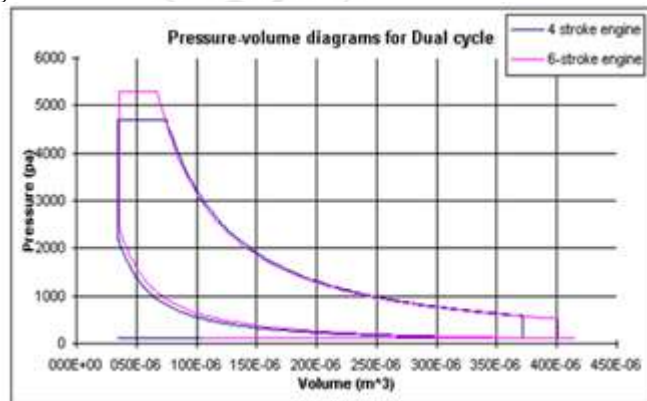
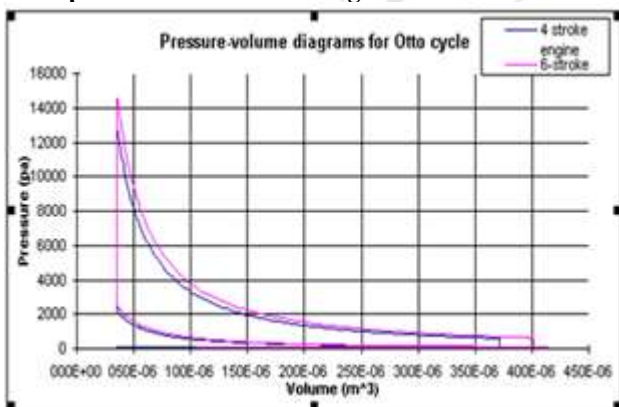


**Cam Follower**

In 4 stroke engine shape of cam follower is flat from bottom. The shape of follower must be changed from flat to roller or

spherical when reducing the duration of opening the valve from 90 degree to 60 degree in six stroke engine.

**“Comparison of Six Stroke Engine with Four Stroke Engine”**



**4. Advantages**

1) Reduction in fuel consumption by at least 40% decrease in scavenging will increase efficiency as the hot and burnt gases from 4th stroke will be utilized to produce 2nd power stroke. Also use of multi-fuel will reduce the fuel consumption

- 2) Increase in power and torque: - Since there are 2 power stroke in six stroke engine hence the power is increased by 50% and torque by 35% of the engine.
- 3) Drastic reduction in pollution:- Increase in fuel efficiency and adoption of multi-fuel will reduce the environmental pollution. The decrease scavenging and proper burning of air-fuel mixture will decrease the Co, HC and NOx emission in environment.

- 4) Removal of cooling system of engine: - The water used for generating extra power stroke can be used for cooling the engine so the additional cooling system can be removed. Removing the cooling system will decrease size of engine and weight of engine making it lighter than 4 stroke engine.

## 5. Conclusion

From this paper we can conclude that to convert a 4 stroke engine into six stroke engine some modification is required and this improvement can help it progress unreasonable time and financial limit. Water injection has improved the cooling system and has made the engine lighter. Not only it has affected the cooling system but also increased the fuel efficiency and has decreased the scavenging. The adoption of six stroke engine by the automobile industry will have a tremendous affect on environment and world economy, assuming up to 40 % reduction in fuel consumption, Six0%-90% in pollution emission depending on the type of second fuel used.

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