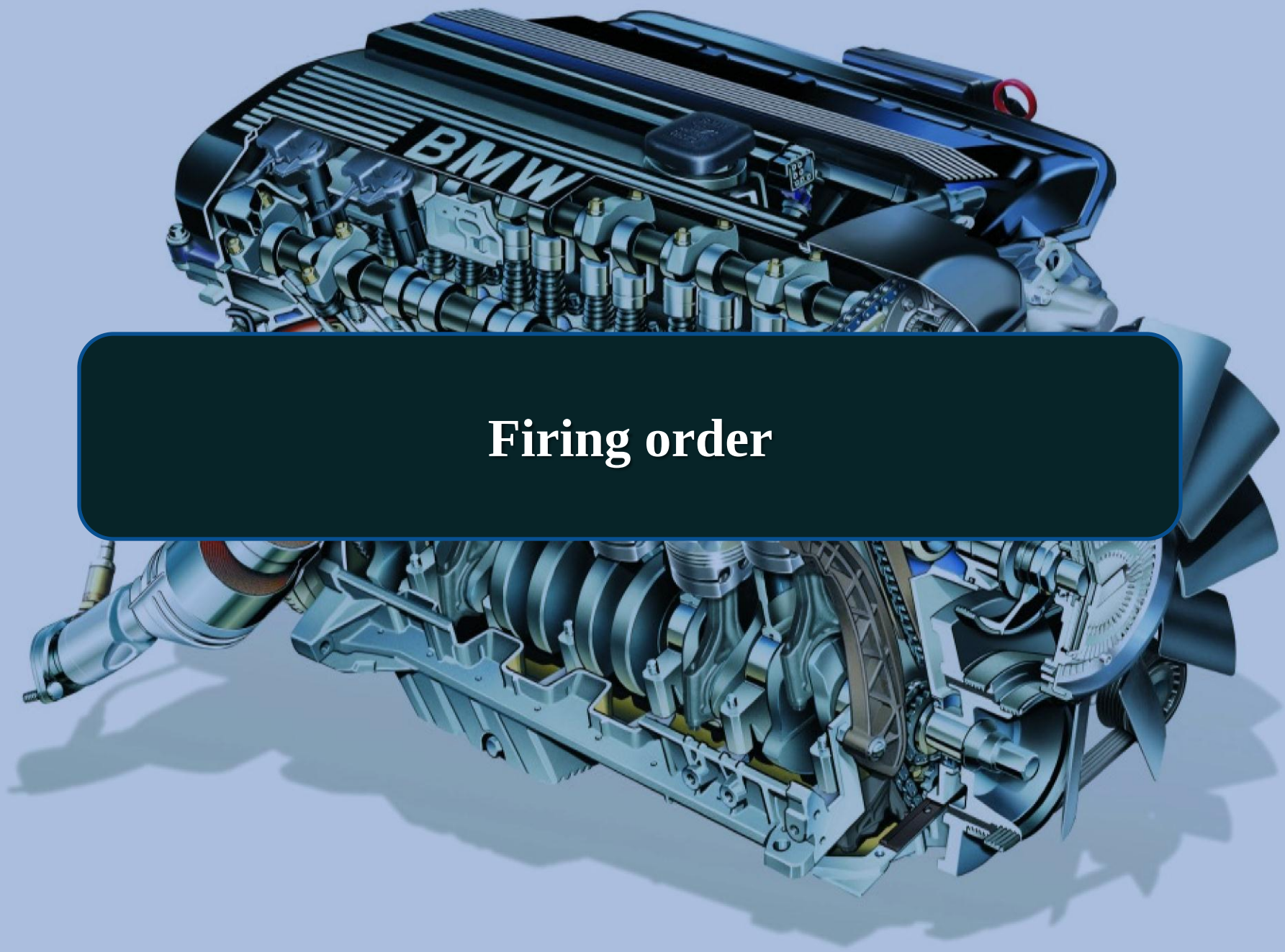


Firing order

Engine Terminology

Firing order:

- The firing order is the sequence of power delivery of each cylinder in a multi-cylinder reciprocating engine.

- This is achieved by sparking of the spark plugs in a gasoline engine in the correct order. Or by the sequence of fuel injection in a diesel engine.

- When designing an engine, choosing an appropriate firing order is critical to minimizing vibration and achieving smooth running, for long engine fatigue life and user comfort, and heavily influences crankshaft design.

ماحوظة: عند ترتيب الاسطوانات للاحتراق يجب عدم جعل ترتيب الحريق بالتتابع لترتيب الاسطوانات فى المحرك و ذلك:

- ليتم توزع الحراره على اجزاء المحرك كلها ولا تذداد فى جزء عن الاخر.
- ليتم توزيع الضغط فى المحرك على عمود المرفق فلا يؤدى الى احداث اهتزاز كبير فى المحرك.

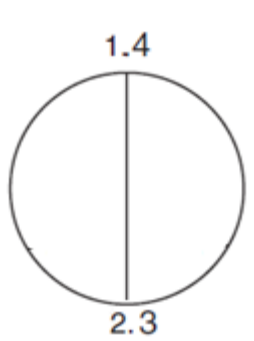
Engine Terminology

In case of 4 cylinder engine:

the four crankpins are in one plane, 180º opposed. Since two pistons each are at the extreme position, the inline design permits following firing orders: 1-3-2-4 or 1-3-4-2

firing order				
1. cylinder	work	exhaust	intake	compression
2. cylinder	intake	compression	work	exhaust
3. cylinder	compression	work	exhaust	intake
4. cylinder	exhaust	intake	compression	work
half a revolution of crank-shaft				

firing order				
1. cylinder	work	exhaust	intake	compression
2. cylinder	intake	compression	work	exhaust
3. cylinder	exhaust	intake	compression	work
4. cylinder	compression	work	exhaust	intake
half a revolution of crank-shaft				

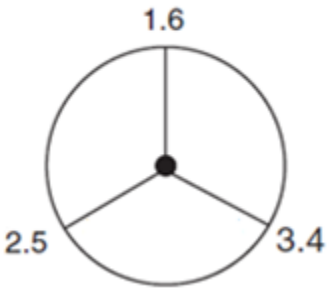


Engine Terminology

In case of 6 cylinder engine:

the crankpins are in one plane, 120º apart. The inline design permits following firing orders: 1-5-3-6-2-4 or 1-4-2-6-3-5

Firing order						
1. cylinder	work	exhaust	intake	compression		
2. cylinder	exhaust	intake	compression	work	exh	
3. cylinder	int.	compression	work	exhaust	intake	
4. cylinder		exhaust	intake	compression	work	
5. cylinder	compression	work	exhaust	intake	com.	
6. cylinder	intake	compression	work	exhaust		
Crank shaft	0	60	120	180	240	300
	360	420	480	540	600	660
	720					



Comparison of SI and CI Engines:

NO	Description	SI Engine	CI Engine
1	Basic cycle	Operated on Otto cycle.	Operated on Diesel cycle
2	Fuel Used	Gasoline fuel, highly volatile fuel and self ignition temperature	Diesel, on- volatile, lower self ignition temp.
3	Induction of fuel	A gaseous mixture of fuel and air is introduced during suction stroke. Carburetor or injector are necessary	Fuel is injected inside the cylinder at high pressure near the end of compression stroke by fuel pump and injector
4	Load control	Quantity control by throttle	Quality control
5	Ignition	Requires an ignition system with spark plug in the combustion chamber.	The injected fuel ignited due to the high pressure and temp. of air at the end of compression stroke.
6	Compression ratio	Operating at range of 6-11. Upper is limited by detonation	Operating at range of 12-24.Upper limit is limited by weight increase of the engine
7	Thermal efficiency	Lower due to the lower comp. ratio	Higher due to the comp. ratio
8	Weight	Lighter than Diesel. Due to lower comp. ratio and lower max press., the cylinder dimension and weight be small.	Heavier than Petrol. Because it has high comp. ratio and higher max pressure so that the cylinder thickness be high and heavier for the same power.
9	Air/Fuel ratio	10:1to 20:1	18:1to 100:1or more according to the load on the engine
10	Operating speed	Up to 6000r.p.m or more	Low speed 400r.p.m,medium 400-1200r.p.m,high speed 1200 to 3500r.p.m or more
11	Weight per unit power	Low (0.5to 4.5kg/kW).	High (3.3to13.5kg/kW).
12	Exhaust gas temperature.	High due to the lower thermal effic.	High due to high thermal effic.
13	Uses	Small passenger cars, scooters, motor cycles, small aircrafts, motor boats	Railway locomotive, heavy commercial road vehicles, ships motor boats, power generation.

Comparison Four Stroke and Two Stroke Cycle Engines:

No	Criteria of comparison	2- stroke engine	4- stroke engine
1	Power Stroke	One working stroke in each cylinder per revolution of the crankshaft	One working stroke in each cylinder per two revolution of the crankshaft
2	Thermal efficiency	Thermal efficiency lower, part load efficiency lesser than four stroke cycle engine. In two stroke engines some fuel is exhausted during scavenging	Thermal efficiency higher, part load efficiency better than two stroke cycle engine
3	Weight and size	Lighter and compact for the same power	Heaver and larger
4	Volumetric efficiency	Volumetric efficiency less due to lesser time of induction	Volumetric efficiency more due to greater time of induction
5	Flywheel size	Smaller	Larger
6	Turning moment	More uniform turning moment and hence lighter flywheel is needed	Turning moment is not uniform and hence heavier flywheel is needed
7	Mechanical efficiency	More due to lesser moving parts	Lesser
8	Construction	Simpler and easy to manufacture	More complicated due to valves and valves mechanism
9	Scavenging	Required and done by fresh charge	More efficient
10	Fuel consumption	More fuel consumption for the same power	Less for the same power
11	Cooling and lubrication	Greater cooling and lubrication .Great rate of wear and tear	Lesser cooling and lubrication. Lesser rate of wear and tear
12	Applications	Used where cost and weight low. Scooters motors cycles lawn movers. Large sizes diesel engine	Cars, buses, trucks, tractors, industrial engines, aero plane, power generation