EXPERIMENT NO:-06

AIM OF THE EXPERIMENT:-

To study about two stroke and four stroke petrol engine.

APPARATUS REQUIRED:-

Sl.no	Name of the apparatus	Specification	Quantity
01	Model of petrol stroke engine	2-stroke	1
02	Model of petrol stroke engine	4-stroke	1

THEORY:-

2-STROKE PETROL ENGINE:-

- A two stroke cycle petrol engine was devised by Dug lad clerk in 1880.
- In this cycle, the suction, compression, expansion, and exhaust takes place during two strokes of the piston. It means that there is one working stroke after every revolution of the crank shaft.
- A two stroke engine has ports instead of valves . the four stages of a two stroke petrol engine are described below:

1. **SUCTION STAGE:-**

- In this stage, the piston ,while going down towards BDC,uncovers both the transfer port and the exhaust port.
- The fresh fuel-air mixture flows into the engine cylinder from the crank case.

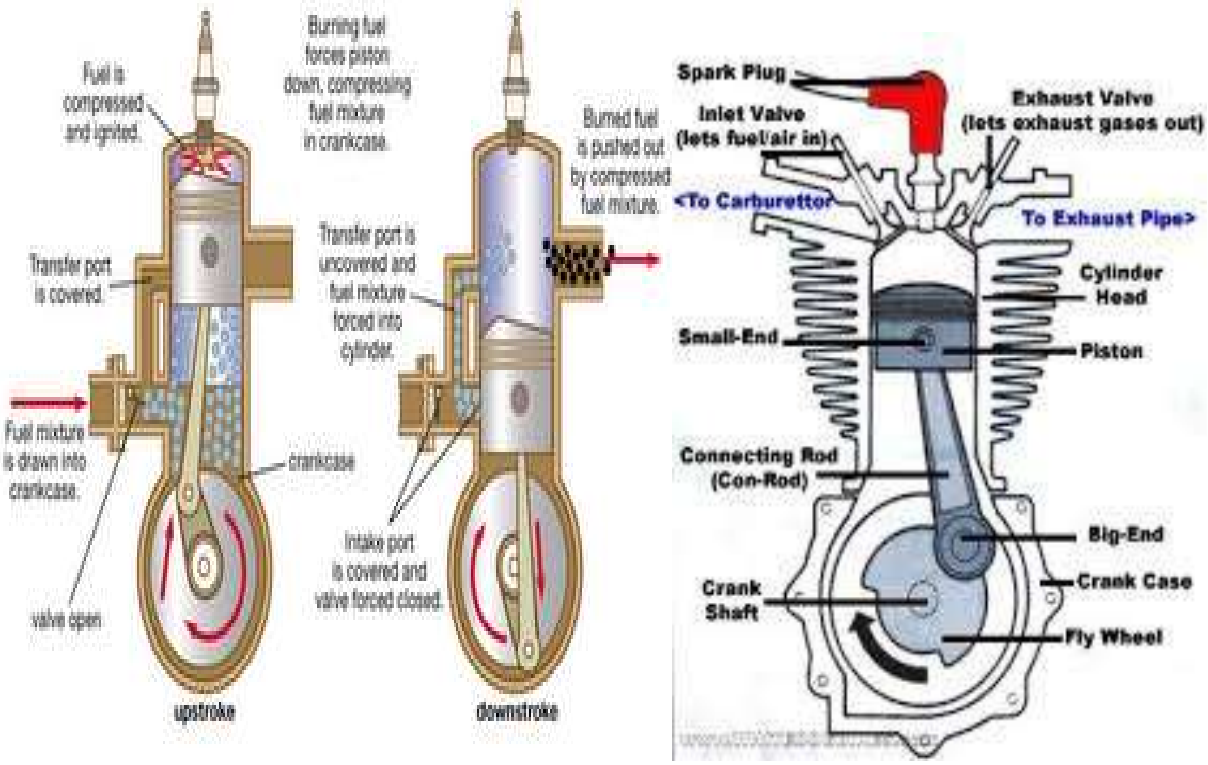
2. COMPRESSION STAGE:-

- In this stage , the piston, while moving up, first covers the transfer port .
- After that the fuel is compressed as the piston moves upwards BDC to TDC.
- In this stage, the inlet port opens and fresh fuel-air mixture enters into the crank case.

3. EXPANSION STROKE:-

- Shortly before the piston reaches the TDC (during compression stroke)the charge is ignited with the help of a spark plug.
- It suddenly increases the pressure and temperature of the product of combustion. But the volume, practically remains constant.
- Due to rise in the pressure, the piston is pushed downwards with a great force.
- The hot burnt gases expand due to high speed of the piston. During this expansion, some of the heat energy produced is transformed into mechanical work.

- **<u>EXHAUST STROKE</u>**:-
  - In this stage, the exhaust port is opened as the piston moves downwards.
  - The product of combustion, from the engine cylinder is exhausted through the exhaust port into the atmosphere.
  - This completes the cycle and the engine cylinders ready to suck the charge again.



4- STROKE PETROL ENGINE:-

Itrequires four strokes of the piston to complete one cycle of operation in the engine cylinder. The four strokes of a petrol engine are described below:

1.SUCTION STROKE:-

- In this stroke, the inlet valve opens and the charge is sucked into the cylinder as the piston moves downward from TDC.
- It continues till the piston reaches its BDC.

2.COMPRESSION STROKE:-

- In this stroke, both the inlet and exhaust valves are closed and the charge is compressed as the piston moves upwards from BDC to TDC.
- As a result of compression, the pressure and temperature of the charge increases considerably.
- This completes one revolution of the crank shaft.

3.EXPANSION STROKE:-

- Shortly before the piston reaches TDC (during compression stroke),the charge is ignited with the help of a spark plug.
- It suddenly increases the pressure and temperature of the products of combustion but the volume,practically remains constant.
- Due to the rise in pressure, the piston is pushed down with a great force. The hot burnt gases expand due to high speed of the piston.
- During this expansion,some of the heat energy produced is transformed into mechanical work.

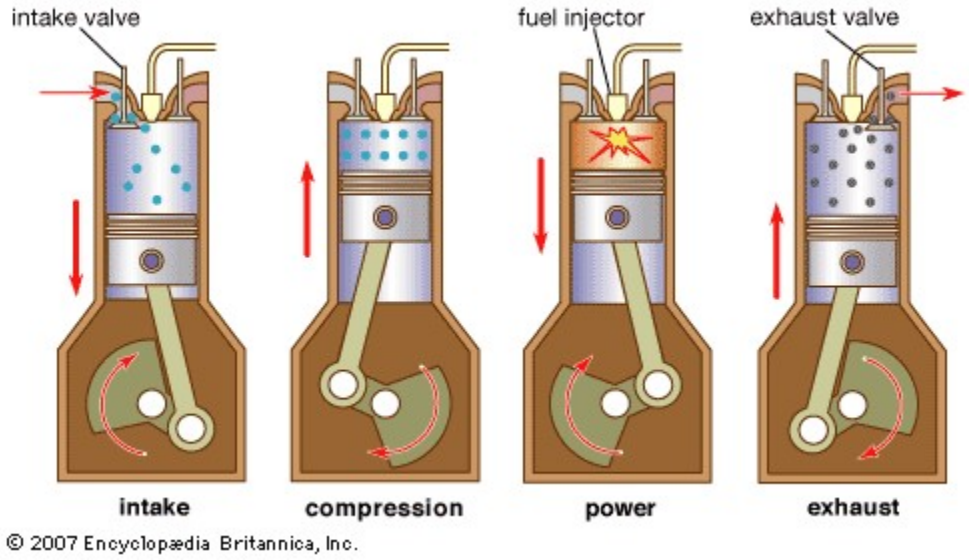
4. EXHAUST STROKE:-

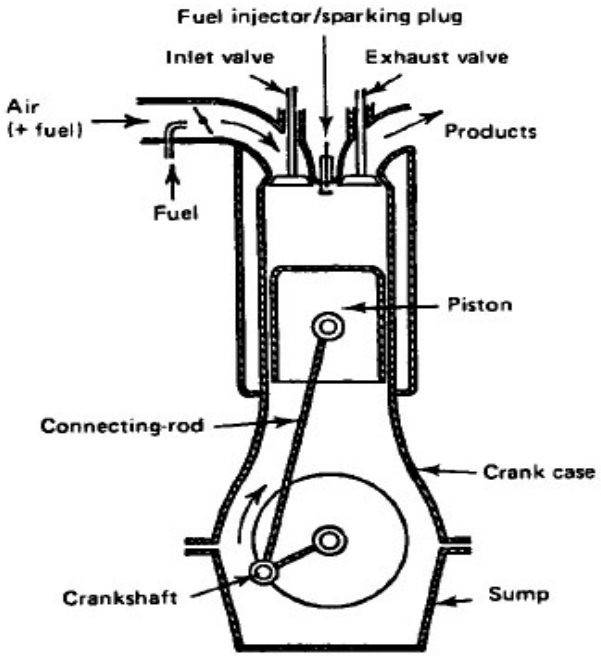
- In this stroke,the exhaust valve is open as piston moves from BDC to TDC.

- This movement of the piston pushes out the products of combustion, from the engine cylinder and is exhausted through the exhaust valve into the atmosphere.
- This completes the cycle, and the engine cylinder is ready to suck the chargeagain.

CONCLUSION:-

From the above experiment we have successfully studied about 2-stroke and 4-stroke petrol engine.





4- STROKE PETROL ENGINE

EXPERIMENT NO:-07

AIM OF THE EXPERIMENT:-

To study about twostroke and four stroke diesel engine.

Sl.no	Name of the apparatus	specification	Quantity
01	Model of diesel engine	2-stroke01	01
02	Model of di0esel engine	4-stroke	02

THEORY:-

2-STROKE DIESEL ENGINE:-

A two stroke cycle diesel engine also has one working stroke after revolution of the crank shaft.All the four stages of a two stroke cycle diesel engine are described below:

1.SUCTION STAGE:-

- In this stage,the piston while going down towards BDC uncovers the transfer port and the exhaust port.
- The fresh air flows into the engine cylinder from the crank case.

2.COMPRESSION STAGE:-

- In this stage,the piston while moving up, first covers the transfer port and then exhausts post.
- After that the air is compressed as the piston moves upward.
- In this stage, the inlet port opens and the fresh air enters in to the crank case.

3.EXPANSION STAGE:-

- Shortly before the piston reaches the TDC (during compression stroke),the fuel oil is injected in the form of very fine spray into the engine cylinder through the nozzle known as fuel injection valve.
- At this moment, temperature of the compressed air is sufficiently high to ignite the fuel. It suddenly increases the pressure and temperature of the products of combustion.
- Due to increase in pressure,the piston is pushed with a great force .The hot burnt gases expand due to high speed of the piston.
- During the expansion,some of the heat energy produced is transformed into mechanical work.

4. EXHAUST STAGE:-

- In this stage, the exhaust port is opened and the piston moves downwards.
- The product of combustion from the engine cylinder is exhausted through the exhaust port into the atmosphere.
- This completes the cycle,and the engine cylinder is ready to suck the air again.

4-STROKE DIESEL ENGINE:-

It is also known compression ignition engine.Because the ignition takes place due to the heat produced in the engine cylinder at the end of compression stroke.The four stokes of the diesel engine are described below:

1.SUCTION STROKE:-

- In this stroke,the inlet valve opens and the pure air is sucked into the cylinder as the piston moves downwards from TDC.
- It continues till the piston reaches in the BDC.

2.COMPRESSION STROKE:-

- In this stroke,both the valves are closed and the air is compressed as the piston moves upwards from BDC to TDC.
- As result of compression,pressure and temperature of the air increases considerably.
- This completes the revolution of the crank shaft.

3.EXPANSION STROKE:-

- Shortly before the piston reaches the TDC, fuel is injected in the form of very fine spray in to the engine cylinder through the nozzle known as fuel injector or fuel injection valve.
- At this moment, temperature of the compressed air is sufficiently high to ignite the fuel.It suddenly increases the pressure and temperature of product of combustion.
- Due to increased pressure, the piston is pushed down with a great force.The hot burnt gases expand due to high speed of the piston.
- During the expansion,some of heat energy is transformed into mechanical work.

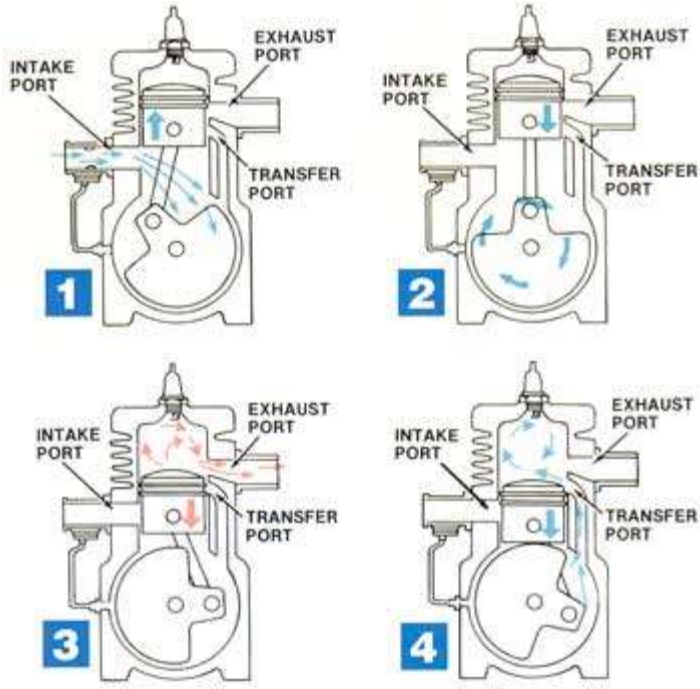
4.EXHAUST STROKE:-

- In this stroke the exhaust valve is open as the piston moves from BDC to TDC.
- This movement of the piston pushes out the product of combustion from the engine cylinder through the exhaust valve into the atmosphere.

- This completes the cycle and the engine cylinder is ready to suck the fresh air again.

CONCLUSION:-

From the above experiment we have successfully studied about the 2-stroke and 4-stroke diesel engine.



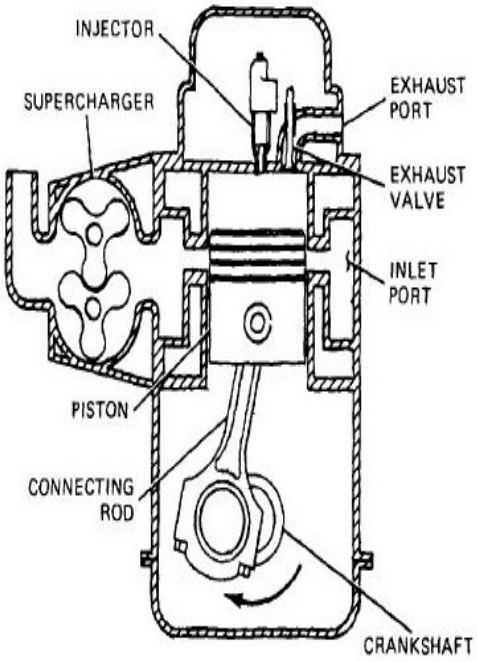
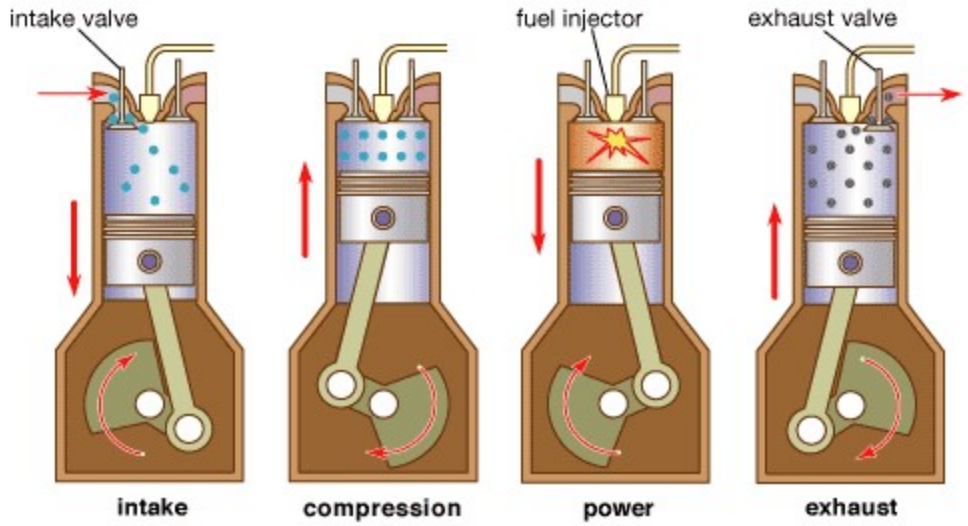
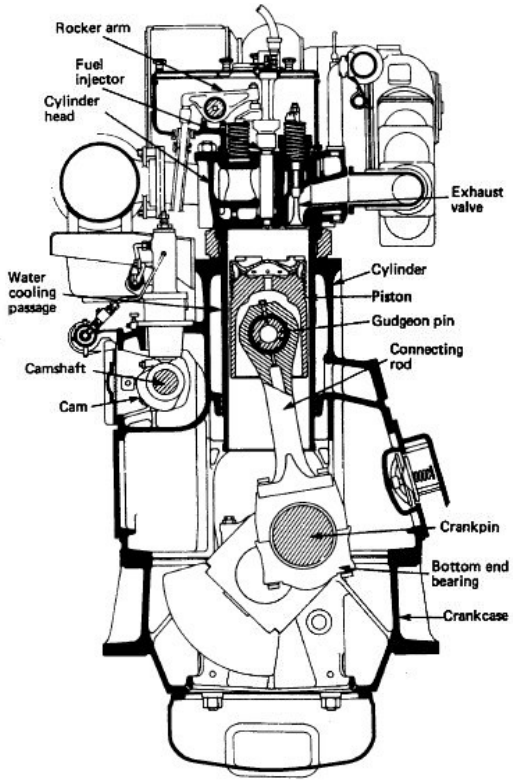


Figure 2-21. The Two Stroke Cycle Diesel Engine





4-STROKE DIESEL ENGINE

EXPERIMENT-2

I.C.ENGINES PERFORMANCE TEST (4 – STROKE DIESEL ENGINES)

Aim:- To conduct load test on single cylinder, vertical, water –cooled diesel engine and hence to determine frictional power and draw the performance characteristic curves.

Apparatus:- Single cylinder diesel engine test rig coupled with rope brake dynamometer, stop watch.
Engine Specification:-

TYPE : 4-STROKE DIESEL ENGINE (water cooled)

MAKE : KIRLOSKAR

BORE : 85 mm

STROKE : 110 mm

SPEED : 1500 rpm

OUTPUT : 5HP

COMPRESSION RATIO : 16.5 : 1

BRAKE DRUM RADIUS : 0.185 m

ORFICE DIAMETER : 15 mm

SPECIFIC GRAVITY OF H.S.D.OIL : 0.85 gm/ml

CALORIFIC VALUE : 10,000 K cal/kg

Description:- The water-cooled single cylinder diesel engine is coupled with a rope brake dynamometer. Separate cooling lines are provided for the drum and the engine. Thermocouples are arranged for sensing the temperature of cooling water consisting of fuel tank mounted on stand, burette with 3-way cock arrangement is provided.

Theory:-

Load test is conducted to study the performance characteristics of the engine. The single cylinder diesel engine is run at a constant speed of 1500 rpm. The engine is loaded in steps of constant interval loads i.e . 0kg, 2kgs, 4kgs ----etc. At each load fuel consumed is determined. The output of the engine is calculated as follow.

$$BP = \frac{\Pi \, WDN \times 9.81}{60000.} \quad \ldots\ldots\ldots KW \qquad W=(W1 - W2) \, Kgf$$

A graph with BP on X- axis and Fuel consumed per hour (FCH) on Y-axis is plotted. The line joining the all data points when extended back, it intercepts the – ve X-axis. The negative intercept magnitude gives the Frictional Power of the engine. The line connecting the data points is known as the WILAN'S LINE.

The other performance parameters like Brake Mean Effective Pressure (Bmep), bth), Mechanical efficiencyηith), Brake thermal efficiency (ηindicated thermal efficiency (mech), Specific Fuel Consumption (SFC) are determined and graphs are plotted.η(

Maximum load on the engine (Wmax) can be calculated as follows

$$W_{max} = \frac{3.68 \times 60000}{\Pi DN \times 9.81}$$

Procedure :- 1. The fuel level in the tank is checked.

2. Lubricating oil level is checked.

3. The engine is started at no load condition and the time taken for 10 ml fuel consumption is noted.

4. A load of 2 kg s is applied on the engine, the spring balance reading w2 , applied load w1 , time taken for 10 cc of fuel consumption are noted down.

5. The above procedure is repeated at different loads like 4kgs, 6kgs, ----- 15 kgs.

6. Frictional Power is obtained from the WILAN'S LINE graph. mech , are calculated.ηbth, η ith, η

7. The other parameters like SFC, Bmep, IP,

8. Graphs are plotted as given below.

i) BP Vs FCH

ii) BP VS SFC BP VS Bmep mechη

iii) BP VS bthη

iv) BP VS ithη

v) BP VS

Observations:-

Model Calculations:-

1. BP = Π WDN x 9.81 ……..KW 60000

2. Fuel consumption per hour (FCH): FCH = 10 x 3600 x 0.85 ……Kg/hr t x 1000

3. SFC = FCH .....Kg/kwhr BP

1. Indicated Power (IP) IP = BP + FP (FP is obtained from WILAN'S LINE graph) mech)η

2. Mechanical Efficiency (mech = BP/IPη

3. Bmep = $\frac{60000 \times BP \text{ bar w}}{LA \text{ nk} \times 10}$

4.ith = $\frac{IP \times 3600 \times 100}{FCH \times CV}$ ……..%η7.

5. bth = $\frac{BP \times 3600 \times 100}{FCHXCV}$ ……%η8.

Where

i) IP and BP are in kilo watts

ii) ii) CV- calorific value of the fuel in kj/kg

Precautions:-

i) The engine should be started and stopped at No Load condition.
ii) Cooling water supply must be ensured throughout the experiment.
iii) The readings should be noted without Parallax error.
iv) Lubricant oil level to be checked.

Review Questions:_-

1. Define mean effective pressure?

2. Briefly discuss the various efficiency terms associated with an engine?

3. Mention the basic aspects covered by the engine performance?

4. What are the methods available for improving the performance of an engine?

5. List the types of exhaust temperatures measured?

Trouble Shooting:-

1. Engine will not start due to air lock in the fuel system- i)Open the bleed- off valve and release the air lock.

2. Engine will not start due to diesel filter choked – i) Remove the filter and clean it.

3. Engine will not start if the holding bolts are loose – i) Tighten the bolts so that required injecting pressure occurs.

4. Abnormal noise - i) Check the engine Jacket cooling system. ii) Check the bearings condition. iii) Check the level and condition of lubricating oil / lubricating filter.

Inference:- Brake Thermal efficiency around 25%

Indicated Thermal efficiency around 35%

Friction Power loss around 16%

Mechanical efficiency around 75%

Specific Fuel Consumption for diesel engine is around

Applications: - Understanding of speed Vs Load Diesel consumption Vs Load per unit time

Aim: To conduct Morse Test on 4-stroke petrol engine and hence to determine the FRICTIONAL mech) of the engine.ηPOWER (FP) and MECHANICAL EFFICIENCY (

Apparatus: Petrol engine test rig coupled with hydraulic dynamometer, stop watch and tachometer.
Engine Specifications:-

Type : 4-cylinder, 4-stroke petrol engine.

Make : HM—1 sz

Rated Power : 75 HP at 5000 RPM

Compression Ratio : 8.5:1

Bore x Stroke : 84mm x 82mm

Clutch : Diaphragm type

Loading : By Hydraulic Dynamometer

Description: A medium capacity 4-stroke vertical water-cooled petrol engine is selected. The engine is coupled with a hydraulic dynamometer. This consists of two half castings and a rotor assembly or rotor shaft and coupling running on ball bearings. The principle of operation of the unit is similar to the fluid coupling. The reaction at the casting is measured by a load cell. The load is read from the digital indicator.

Theory: Morse test conducted on multi cylinder engines to determine the frictional power, indicated power and mechanical efficiency of the engine. The power available at the shaft (Brake Power) is always less than the indicated power of the engine. These two parameters are related as follows.

IP=BP+FP …….(1)

Where IP= Indicated Power

BP= Brake Power

FP= Frictional Power

In this experiment the engine is run at a constant speed of 1500 rpm, to keep the FP of the engine constant. To calculate the IP of a particular cylinder, say nth cylinder, the spark plug is short circuited to that cylinder and speed is kept constant at 1500 rpm. Then IP of that nth cylinder is given by

(IP)n = (BP)- (BP)n off ……..(2)

Where BP= Brake Power of the engine with all cylinders working

=_W x N / 2720 ----------(3)

(BP)n off = Brake power of the engine with fuel supply cut-off to nth cylinder.

The hydraulic dynamometer works at an operating pressure of 1 kg/ cm2 The maximum load on the engine is calculated as follows

. 55 Kw= Wmax x 5000/2720 ……..(4)

Wmax = 30 kgs

Procedure:

1. The Fuel level and lubricating oil level are checked.

2. The Engine is started and the load is adjusted to 8 kg at an engine speed of 1500 rpm.

3. The engine is allowed to run for some time at this condition. Then first cylinder is cutoff by operating the lever , So that spark plug is short circuited.

4. The engine speed is adjusted to 1500 rpm by decreasing the load on the engine. The load at which speed becomes 1500 rpm is noted. In no case the accelerator be touched while adjusting the speed.

5. The first cylinder is put on to working condition by operating the lever and the engine is allowed to run for some time at this state

. 6. The second cylinder is cut-off and the load at which speed is maintained at 1500 rpm is noted.

6. The above procedure is repeated for the third and fourth cylinders.

OBSERVATION TABLE :

SL NO	Cylinder status	Speed (rpm)	Load (kg)
1	All cylinders on	1500	1500
2	First cylinder cut-off	1500	
3	Second cylinder cut-off	1500	
4	Third cylinder cut-off	1500	
5	Third cylinder cut-off	1500	

Model Calculations :

1. Brake Power (BP): BP= $\frac{W \times N}{2720}$……..KW

2. Brake power of the engine when nth cylinder cut-off,(BP)n off (BP)n-off =Wn-off x N / 2720……KW

3. Indicated Power of nth cylinder (IP)n (IP)n = (BP) - (BP)n-off ……..KW

4. Indicated power (IP) of the engine: IP = (IP)1 + (IP)2 + (IP)3 + (IP)4 .....KW

5. Frictional Power of the engine (FP) : FP = IP - BP ……KW mech) :η

6. Mechanical Efficiency (mech) = BP x 100/IP

SL NO	CYLINDER NO	IP(KW)
1	1	
2	2	
3	3	
4	4	

Review Questions:-

2. Briefly discuss the various efficiency terms associated with an engine?

3. What are the methods available for improving the performance of an engine?

4. List various methods available for finding frictional power of an engine?

5. Why morse test is not suitable for single cylinders engine?

6. Explain the principle involved in the measurement of brake power?

Trouble Shooting :-

4. Engine will not start due to air lock in the fuel system-open the bleed - off volve.

5. Engine refuses to start---- Petrol tap shut off.

No petrol in the tank

Throttle disconnected, too much air through carburetor.

Pilot jet blocked.

Checked petrol filter

. Fuel pump not operating

7. Engine Started & stopped after few minutes of running – Controls out of order Stripper timing gear Valve sticking Broken valve No valve tappet clearance. Insufficient lubrication

Applications:- Performance data of engine obtained from theoretical analysis is compared with experimental results and approved for validation.

Inference:- Friction looses as in the case of pistons , bearings , gears, valve mechanisms, these losses are usually limited from 7 to 9 percent of the indicated out put. Power observed by engine axillaries such a fuel pump, lubricating oil pump, water collecting pump, radiator, magneto & distributor, electric generator for battery charging etc. These losses may account for 3 to 8 percent of the indicated out put. Ventilating losses are usually below 4 percent of indicated out put.

Pumping losses and power observed by the scavenging pump are account 2 to 6 percent of the indicated out put. Excusing all, the mechanical efficiency of engine varies from 65 to 85 %.
Precautions:-

1. Only one cylinder should be cut-off at a time.

2. The engine should not be operated with a cut-off cylinder for a long time

. 3. The engine should be started and stopped at no load condition.

. 4. The load applied on the engine should not exceed the maximum load that can be applied

5. The lubricating oil level should be maintained sufficiently.

6. Cooling water supply must ensured throughout the experiment.