SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19OE120 AUTOMOTIVE ELECTRONICS

III YEAR /IV SEMESTER MECHATRONICS

Unit 1 – INTRODUCTION TO ECU

Topic 3: Engine Performance Parameters – PART -A

Engine Performance Parameters Following are the different parameters of engine performance:

1.Work
2.Energy
3.Power
4.Horse Power
5.Torque
6.Bore and Stroke
7.Piston displacement
8.Engine displacement
9.Compression Ratio
10.Indicated Horse Power (I.H.P)
11. Brake Horse Power (B.H.P)
12. Frictional Horse Power (F.H.P)
13. Indicated Thermal Efficiency
14. Brake Thermal Efficiency
15. Mechanical Efficiency
16. Volumetric Efficiency
17. Relative Efficiency
18. Mean Effective Pressure
19. Mean Piston Speed
20. Specific Power Output
21.Specific Fuel Consumption
22. Air-Fuel Ratio
23. Calorific Value of the Fuel

work

When an object is moved by the application of a force, work is said to be done. It is measured by the product of the distance the body moves and the force applied to it. Thus,

Work = Distance X force,

If the distance is measured in meters, and force in kilogram, the unit of work will be m-kg.

Energy

Energy is the term for the ability or capacity to do work. This is done on an object, energy is stored in that object. If a 10-kilogram weight is lifted by 5 meters, the weight will store 50 m-kg of work. Similarly, if the spring is compressed, energy is stored in it. and it can do work.

Power

Power is the rate of doing work. The work can be done slowly or rapidly. The rate at which the work is done is measured in terms of power. A horse can do the work slowly, while a machine can do a great amount of work in a short time.

Horse Power

A horsepower (h.p.) is the power of one horse, or a measure of the rate at which a horse can work, A 10 h.p. engine, for example, can do the work of 10 horse.
A horsepower is 75 m-kg/sec or 4500 m-kg/min shown in figure. As illustrated, the horse walks 50 meters in one minute, lifting the 90 kg weight. The amount of work done is 50X90-4500 m-kg/min.
Horsepower is the bigger unit of power. Power is generally expressed in horsepower

1 Horse Power = 75 m-kg/sec = 4500 m-kg/min.

Torque

Torque is the twisting or turning effort to the product of the force and its perpendicular distance to the point of rotation. This may or may not result in speed. Power is something else again. It is the rate at which work is being done, and this means that something must be moving.

Torque is measured in kg-m (not to be confused with m-kg of work). If a 20 kg force is applied on the shaft through a crank radius of m to rotate a wheel, you would be applying 20x ½ = 10 kg-m of torque to the crank.

You would be applying the torque regardless of whether or not the crank was turning, and so long as you continued to apply the 20 kg force to the crank handle.

Bore and Stroke

It is the inner diameter of the cylinder, which is known as a bore. Stroke is the distance the piston travels from the bottom dead center to the top dead center. The size of an engine cylinder is referred to in terms of the bore and stroke.

Piston Displacement

Piston displacement is the amount displaced by the piston as it moves from its top dead center to the bottom dead center position in the engine cylinder. It determines the size of the piston in cubic centimeters. This volume depends on the cylinder bore and the piston stroke.

Engine Displacement

Engine displacement has been defined as the total volume displaced by all the pistons as they move from their top dead center to bottom dead center position. It determines the size of an engine in cubic centimeters (cc). This volume depends on the cylinder diameter (bore). piston stroke and the number of cylinders.

$$Engine\ Displacement = \frac{\pi D^2}{4} L \times N\ cc$$

where,
- D = Ddiameter of cylinder in cm
- L = length of stroke in cm
- N = No. of the cylinder.

Compression Ratio

It is the ratio of the volume of the charge in the cylinder above the piston at the bottom dead center and the volume of the charge when the piston is at the top dead center.

Indicated Horse Power (I.H.P.)

The power actually developed inside the engine cylinder by the combustion of the fuel is called indicated horsepower. It is given by the relation.

Brake Horse Power (B.H.P.)

The power which the engine actually delivers to do the outside work is called brake horsepower. It is usually 70 to 85% of its indicated horsepower. It can be measured by some measuring instruments like prony brake or dynamometer, and is given by the following relation,

Frictional Horse Power (F.H.P.)

Output power (or B.H.P.) of an engine is always less than the input power (or I.H.P.) because some power is lost in overcoming the friction between the moving parts. The power lost in friction in the engine mechanism is called frictional horsepower. It is equal to the difference between the I.H.P. and B.H.P. Thus,

F.H.P. = I.H.P. – B.H.P.

Indicated Thermal Efficiency

The quantity of power developed by the combustion of fuel in the cylinder is called the indicated power. And The actual amount of energy stored in the fuel = mass of fuel × calorific value of the fuel is known as fuel energy. The ratio between the Indicated Power to Fuel Energy is termed **Indicated Thermal Efficiency**.

Brake Thermal Efficiency

The amount of power produced by a crankshaft is called brake power. The ratio between the Brake power to Fuel Energy is called **Brake Thermal Efficiency**

Mechanical Efficiency

Mechanical efficiency is defined as the ratio of power output to the power developed in a cylinder. In other words, it is the ratio of brake power to the indicated power.

Volumetric Efficiency

The volume of the air-fuel mixture drawn into the cylinder at atmospheric pressure during the intake stroke compared to the volume of the cylinder is known as volumetric efficiency.

Relative Efficiency

Relative efficiency is the ratio of the actual cycle and the thermal capacity of the ideal cycle. It is also known as the Efficiency ratio.

Mean Effective Pressure

It can be defined as the average pressure inside the cylinder of the internal combustion engine based on the resulting power output. For any type of engine, there will be two mean effective pressures. It is the Indicated mean effective pressure (p_{im}) and brake mean effective pressure (p_{bm}).

Mean Piston Speed

The mean piston speed is the twice length of stroke and rotation speed of the crankshaft.

Specific Output Power

The specific Power output can be commonly defined as the power output per unit piston area.

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Air-fuel Ratio

It is considered very important in the performance of the engine. In a spark-ignition engine, the air-fuel ratio will be the same for most operations. Whereas in the compression engines, the fuel is entered individually with the help of a fuel injector so that if the load needs to be increased, the amount of fuel will increase directly into the cylinder.

Calorific Value of the Fuel

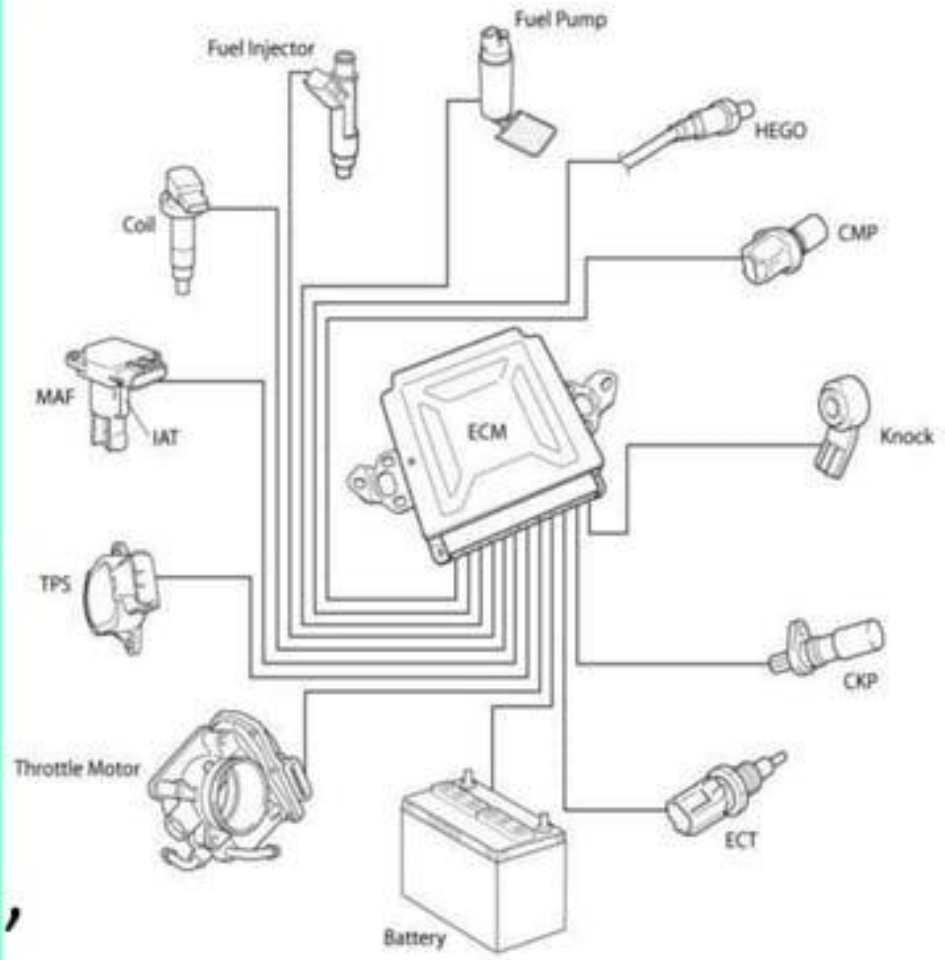
The calorific value of the fuel can be defined as the amount of thermal energy delivered per unit quantity of fuel when it is fully burned.

PERFORMANCE OF ENGINE

To increase the performance o f engine

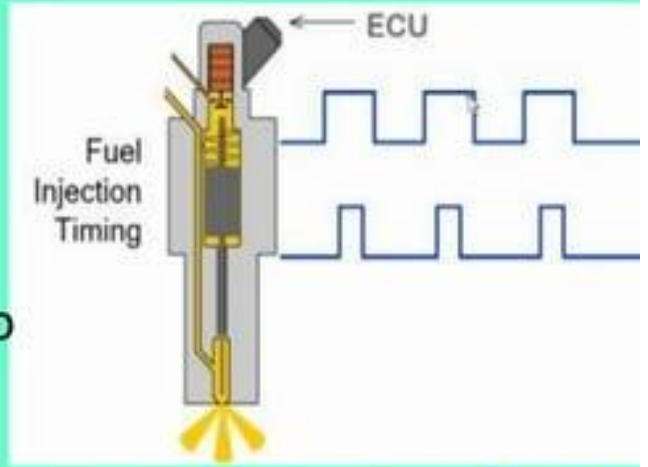
Sensors :

1)Fuel injection
2)Knocking
3)Air-Flow sensor
4)Engine speed
5)Cam
6)Thermistor etc..,



FUEL INJECTOR SENSOR

A fuel injector is nothing but an electronically controlled valve.

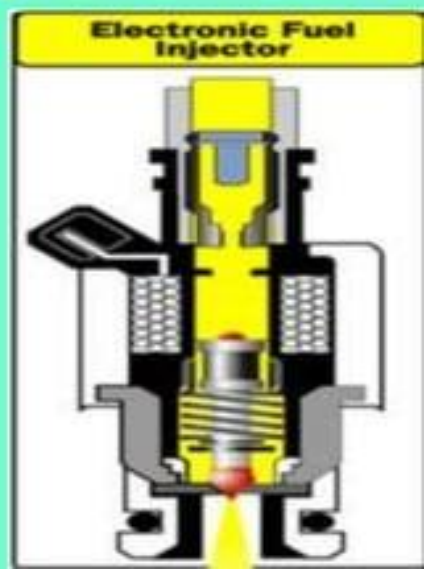


Indirectly controlled variable : Air-fuel ratio

Directly controlled variable : Exhaust oxygen content

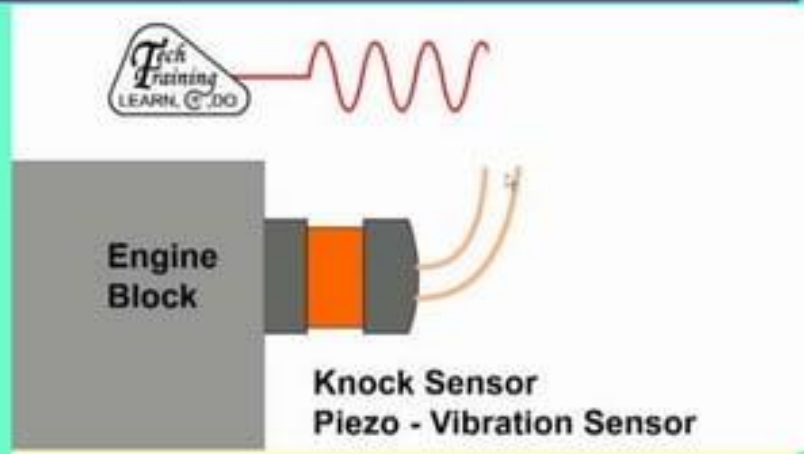
Manipulated variable : Quality of injection fuel

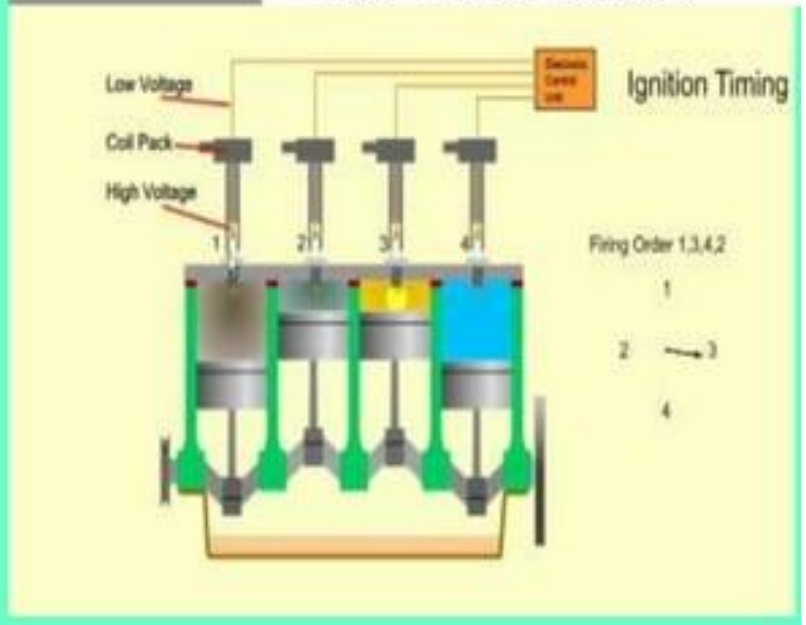
SENSOR: Zirconia or Titania based electro-chemical



KNOCKING SENSOR

- **Indirectly controlled variable ;**Knock
- **Directly controlled variable;** Knock sensor output
- **Manipulated variable ;**Ignition timing
- **Sensor ;**Piezo-electric accelerometer
- **Actuator ;**Ignition coil switch. Transistor
- **Sensor mounting location ;**Cylinder block or head

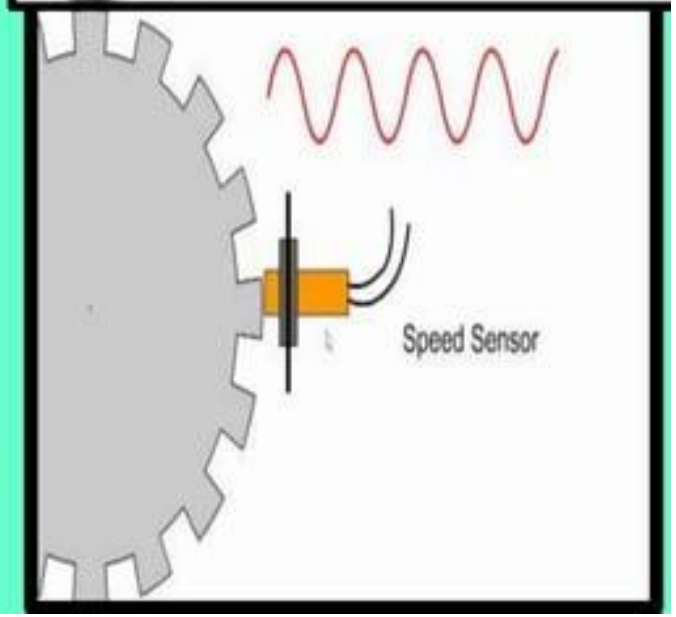




ENGINE SPEED SENSOR

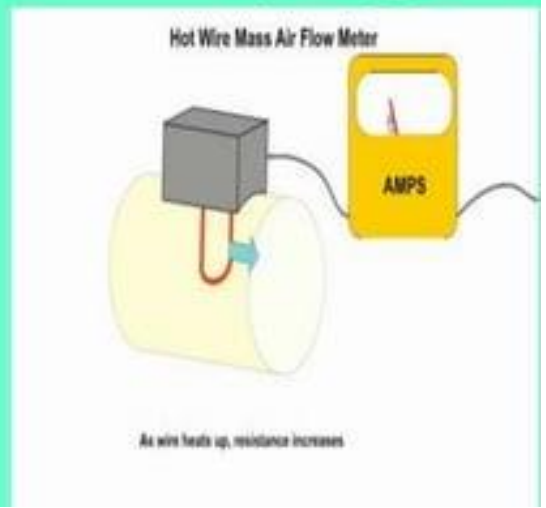
- ***Engine speed sensor*** – Generally ***a Magnetic Speed Sensor detects when ring gear teeth, or other ferrous projections, pass the tip of the sensor***.

- **Measured variable** ;Wheel speed and engine speed (Vehicle nav. Systems)
- **Direct/indirect measurement** ;Direct measurement
- **Sensor technology/ reference** ;Magnetic reluctance or Hall effect device
- **Sensor mounting location** ;Brake assembly and crankshaft flywheel respectively



AIRFLOW SENSOR

- It is also called as load sensor
- **Measured variable ;**Mass airflow
- **Direct/indirect measurement ;**Direct and indirect measurement of fuel injector basic pulse width
- **Sensor technology/ reference ;**Various forms including ‘flap’ type, ‘hot-wire’, Karman vortex and thick-film diaphragm
- **Sensor mounting location ;**Within air intake



TEMPARATURE SENSOR

- **Measured variable ;**Temperature
- **Direct/indirect measurement ;**Direct measurement at various locations

Sensor technology/ reference ;
Thermistor or thermocouple depending on temperature range

- **Sensor mounting location ;**Intake air, outside air, catalytic converter, engine coolant, hydraulic oil .