

Title : MPFI & Spray Formation

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Lecture No : 2

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MPFI System

• The main purpose of the Multi-Point Fuel Injection (MPFI) System is to supplya proper ratio of gasoline and air to the cylinders. These system function under two basic arrangements viz.,

(i) Port injection(ii) Throttle body injection





Port InjectionIn this system, the injector is placed on the side of the intake manifold near the intake port. The injector sprays gasoline into the air, inside the intake manifold.



•The gasoline mixes with the air in a reasonably uniform manner. This mixture of gasoline and air then passes through the intake valve and enters into the cylinder.

Port Injection – contd.

• Every cylinder is provided with an injector in its intake manifold. If there are six cylinders, there will be six injectors. Figure shows simplified view of a port or multi point fuel injection (MPFI) system.



Throttle Body Injection

•Figure illustrates the simplified sketch of throttle body injection system (single point injection). This throttle body is similar to the carburetor throttle body, with the throttle valve controlling the amount of air entering the intake manifold.



Remark

• The port injection system and the throttle-body injection system may be either pulsed systems or continuous systems. In both systems, the amount of gasoline injected depends upon the engine speed and power demands.

•In some literature MPFI systems are classified into two types viz.,

D-MPFI and L-MPFI.

D-MPFI System

•The D-MPFI system is the manifold fuel injection system. In this type, the vacuum in the intake manifold is first sensed. Further, it senses the volume of air by its density. Figure shows the block diagram regarding the functioning of the D-MPFI system.



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D-MPFI System – contd.

•As air enters into the intake manifold, the manifold pressure sensor detects the intake manifold vacuum and sends the information to the ECU. The speed sensor also sends information about the rpm of the engine to the ECU.

•The ECU in turn sends commands to the injector to regulate the amount of gasoline supply for injection. When the injector sprays fuel in the intake manifold the gasoline mixes with the air and the mixture enters the cylinder.

L-MPFI System

•The L-MPFI system is a port fuel- injection system. Here, the fuel metering is regulated by the engine speed and the amount of air that actually enters the engine. This is called *air-mass metering* or *air-flow metering*. This block diagram of L-MPFI system is shown.



L-MPFI System – contd.

- As air enters into the intake manifold, the air flow sensor measures the amount of air and sends information to the ECU. Similarly, the speed sensor sends information about the speed of the engine to the ECU.
- The ECU processes the information received and sends appropriate commands to the injector to regulate the amount of gasoline supply for injection. When injection takes place, the gasoline mixes with the air and mixture enters the cylinder.

Functional Divisions of MPFI System

•The MPFI system can be functionally divided into the following there main components:

(i) Electronic Control System(ii) Fuel System(iii) Air Induction System



•The MPFI- electronic control system is shown in the above block diagram. The sensors that monitor intake air temperature, the oxygen, the water temperature, the starter signal and the throttle position send signals to the ECU.

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MPFI Electronic Control System – contd.

•The air-flow sensor sends signals to the ECU regarding the intake air volume. The ignition sensor sends information about the engine speed. The ECU processes all these signals and sends appropriate commands to the injectors to control the volume of the fuel for injection. When necessary the cold-start injector timing switch off the ECU operates the cold start injector which is a part of the fuel system.

MPFI Fuel System

• Here, fuel is supplied by the fuel pump. At the time of starting, the cold start injector is operated by the cold start injector time switch. The cold start injector injects fuel into the air intake chamber, thus enriching the air-fuel mixture. The pressure regulator regulates the pressure of the fuel. The injectors receive signals from the ECU and inject the fuel into the intake manifold.



MPFI Air Induction System

•Here, the air cleaner, the air-flow meter, the throttle body and the air valve supply a proper amount of air to the air intake chamber and intake manifold. The quantity of air supplied is just what is required for complete combustion.



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Spray Formation

When the fuel is forced through the nozzle holes under high pressure it is disintegrated into fine droplets due to aerodynamic resistance of the dense air present in the combustion chamber.

The disintegration of the fuel into fine droplets depends upon the relative velocity of the fuel and air, and on physical characteristics of both fuel and air.

With **small L/d ratio** from the nozzle, <u>outlet velocity is high</u>, <u>small drop size</u>, <u>less</u> <u>penetration</u>, <u>more atomisation</u> and <u>turbulent in nature</u>.

While high L/d ratio from the nozzle, <u>outlet velocity is small</u>, <u>large drop size</u>, <u>greater</u> penetration less atomisation and <u>flow configure is streamlined</u>.

For diesel engine L/d ratio is usually between 2 to 5, higher value being used for very large cylinder.

The main factor which determine the penetration of the spray are the momentum of the droplets (diameter x velocity) and the density of air in the combustion chamber. Higher the momentum greater is the penetration.

•Assignment 5: Q. 5 Draw neat and labeled diagram of multi point fuel injection (MPFI) system for modern automobile engines and explain its working.

•Hard copy submission date (31/3/2020).

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