Gasoline as an Automotive Fuel

Gasoline is the most common type of automotive fuel. It is still an abundant fuel source and the highly flammable part of crude oil. Extra chemicals, called additives (detergents, antioxidants, etc.), are mixed into gasoline to improve its operating characteristics. Antiknock additives slow down the burning of gasoline, which helps prevent engine ping, or knock (knocking sound produced by abnormal, rapid combustion).

Gasoline Octane Ratings

The octane rating of gasoline is a measurement of the fuel's ability to resist knock or ping. A high octane rating indicates the fuel will not knock or ping easily. High-octane gasoline should be used in high-compression engines and turbocharged engines. Low-octane gasoline is suitable for low-Compression engines.

Gasoline Combustion,

For gasoline (or any other fossil fuel) to burn properly, it must be mixed with the right amount of air. The mixture must then be compressed and ignited. The resulting combustion produces heat, expansion of gases, and pressure. The pressure pushes down on the piston to rotate the crankshaft. Air-Fuel Mixture, for proper combustion and engine performance, the correct amounts of air and fuel must be mixed. If too much fuel or too much air is used, engine power, fuel economy, and fuel economy and tail-pipe emissions will suffer. The ideal air/fuel mixture ratio of 14.7:1—14.7 parts air to 1 part fuel, by weight—is called the stoichiometric and is a chemically perfect correct air-fuel ratio. Under constant engine conditions, this ratio helps ensure that all the fuel is burned during combustion.

Abnormal Combustion

Abnormal combustion occurs when the flame does not spread evenly and smoothly through the combustion chamber. The lean air-fuel mixtures, high operating temperatures, and low-octane fuels of today make abnormal combustion a problem. Detonation, detonation results when part of the unburned air-fuel mixture explodes violently. This is the most severe and engine-damaging type of abnormal combustion. Engine knock is a symptom of detonation. The combustion chamber pressure rises so quickly that parts of the engine vibrate. Detonation sounds like a hammer hitting the side of the engine.

Spark Knock, is another engine combustion problem caused by the spark plug firing too soon in relation to the position of the piston and crankshaft when the spark plug ignites the air/fuel mixture. Spark timing that is advanced too far causes combustion pressure to slam into the flame front.

Fuel Systems

Today there are two main fuel delivery systems, Throttle Body Injection (TBI), and Electronic Multiport Fuel Injection (EFI). Throttle body injection system uses one or two injector valves mounted in a throttle body assembly—a device very similar to a carburetor, but without the problems caused by poor fuel combustion. There are two main types of control for multi-port systems: The fuel injectors can all open at the same time, or each one can open just before the intake valve for its cylinder opens (this is called sequential multi-port fuel injection).

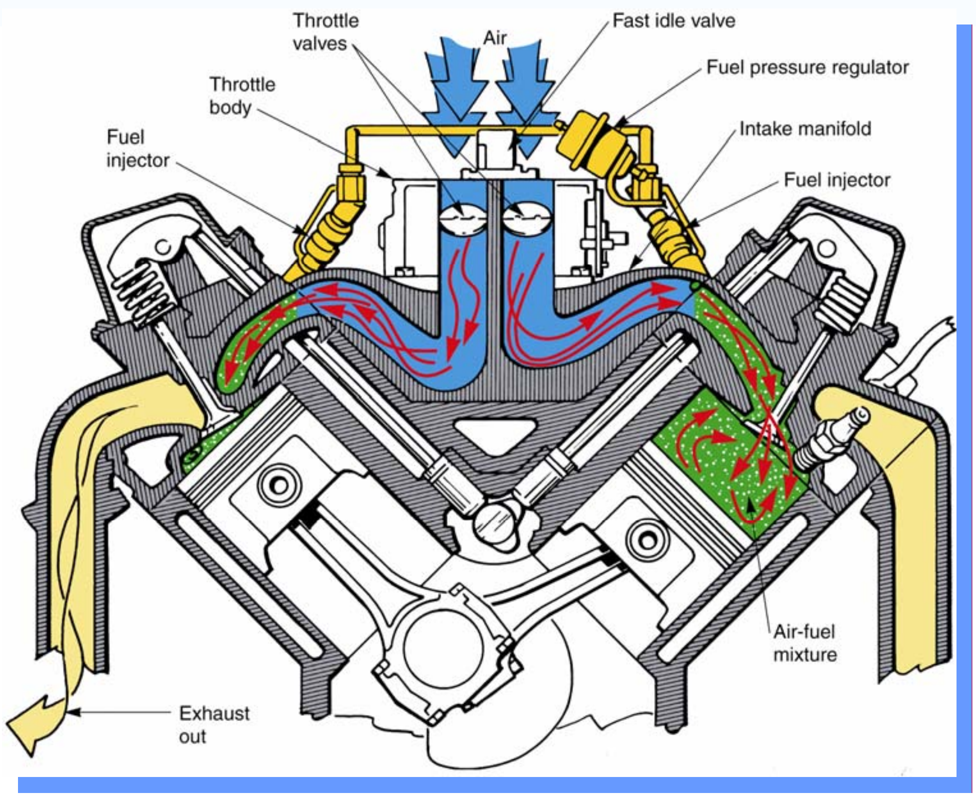
The advantage of sequential fuel injection is that if the driver makes a sudden change, the system can respond more quickly because from the time the change is made, it only has to wait only until the next intake valve opens, instead of for the next complete revolution of the engine.

A TBI assembly includes the throttle body housing (the metal casting that holds the injectors), fuel pressure regulator, throttle valves, and other parts. The TBI throttle body housing bolts on to the intake manifold. Throttle plates are mounted in the lower section of the housing. This setup incorporates a linkage mechanism, or cables, to connect the throttle plates with the accelerator. An inlet fuel line connects to one fitting on the throttle body housing. The TBI pressure regulator consists of a fuel valve, diaphragm, and spring. When fuel pressure is low, such as when starting the engine, the spring holds the fuel valve closed. This causes pressure to build as fuel flows into the regulator form the electric fuel pump.

Electronic Multiport Injection injector systems use a computer, engine sensors, and one solenoid injector for each engine cylinder. An EFI injector valve is usually press fit into the runner (port) in the intake manifold. Each injector is aimed to spray fuel toward an engine intake valve(s). The outlet end of the injector produces the fuel spray pattern for optimum combustion. An O-ring real—a rubber seal that fits around the outside of the injector body—seals the injector valve to the intake manifold.

A fuel filter is a filterT in the fuel line that screens out dirt and rust particles from the fuel. Fuel filters serve a vital function in today's modern, tight-tolerance engine fuel systems. Unfiltered fuel may contain several kinds of contamination, for example paint chips and dirt that has been knocked into the tank while filling, or rust caused by moisture in a steel tank. If these substances are not removed before the fuel enters the system, they will cause rapid wear and failure of the fuel pump and injectors, due to the abrasive action of the particles on the high-precision components used in modern injection systems. Fuel filters also improve performance and reduces tail-pipe emissions, as the less contaminants in the fuel, the more efficiently and cleaner it can burn.

Fuel filters need to be maintained at regular service intervals. This is usually a case of simply disconnecting the filter from the fuel line and replacing it with a new one, although some specially designed filters can be cleaned and reused many times. If a filter is not replaced regularly it may become clogged with contaminants and cause a restriction in the fuel flow, causing an appreciable drop in engine performance as the engine struggles to draw enough fuel to continue running normally.

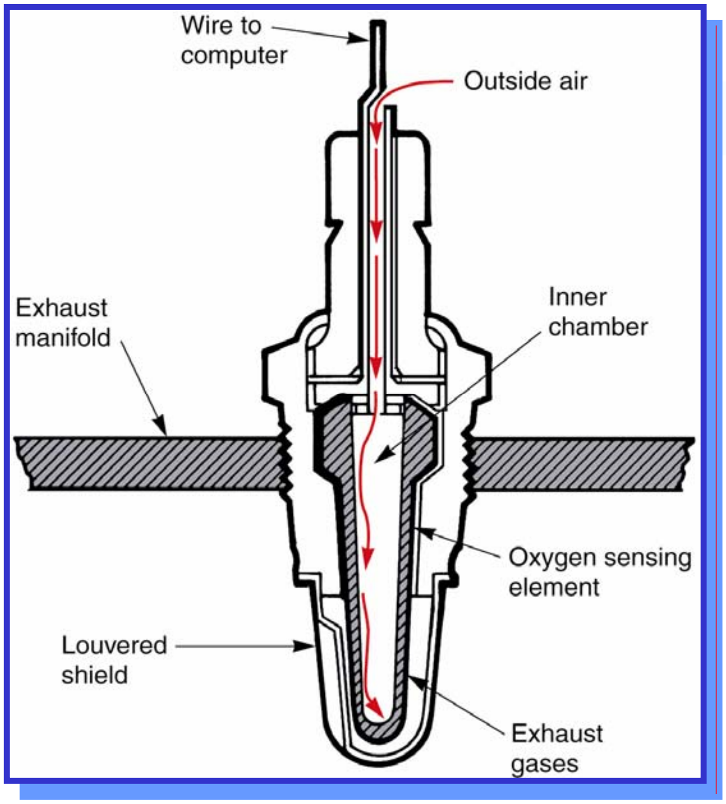


Air Induction System
Throttle plates control airflow

Engine Sensors

In order to provide the correct amount of fuel for every operating condition, the engine control unit (ECU) has to monitor a huge number of input sensors. The most common and important are:

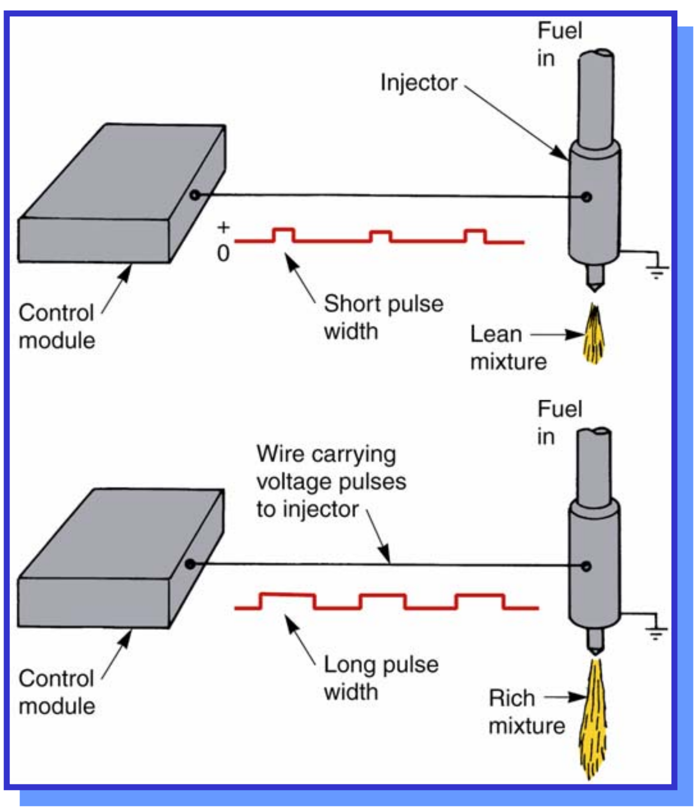
- Mass airflow sensor - Tells the computer the mass (weight, volume and density) of air entering the engine
- Oxygen sensor(s) - Monitors the amount of oxygen in the exhaust so the ECU can determine how rich or lean the fuel mixture is and make adjustments accordingly
- Throttle position sensor - Monitors the throttle valve position (which determines how much air goes into the engine) so the ECU can respond quickly to changes, increasing or decreasing the fuel rate as necessary
- Coolant temperature sensor - Allows the ECU to determine when the engine has reached its proper operating temperature
- Voltage sensor - Monitors the system voltage in the car so the ECU can raise the idle speed if voltage is dropping (which would indicate a high electrical load)
- Manifold absolute pressure sensor - Monitors the pressure of the air in the intake manifold. The amount of air being drawn into the engine is a good indication of how much power it is producing; and the more air that goes into the engine, the lower the manifold pressure, so this reading is used to gauge how much power is being produced
- Engine speed sensor - Monitors engine speed, which is one of the factors used to calculate the pulse width



Oxygen Sensor (O2 Sensor)

Increase in exhaust oxygen from lean mixture causes oxygen sensor voltage to increase.

Decrease in exhaust oxygen from rich mixture causes oxygen sensor voltage to decrease.



Injector Pulse Width

With information from all the sensors, the computer (ECM) controls the Pulse Width—the amount of fuel injected into the cylinder determined by the time (length) of the Pulse Width.

In conclusion,