Electronic Fuel Injection

By

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A modern gasoline injection system uses pressure from an electric fuel pump to spray fuel into the engine intake manifold.

Like a carburetor, it must provide the engine with the correct air-fuel mixture for specific operating conditions.

Unlike a carburetor, however ,PRESSURE, not engine vacuum, is used to feed fuel into the engine .

This makes the gasoline injection system very efficient

A gasoline injection system has several possible advantages over a carburetor type of fuel system.

Some advantages are as follows:

* Improved atomization. Fuel is forced into the intake manifold under pressure that helps break fuel droplets into a fine mist.
* Better fuel distribution. Equal flow of fuel vapors into each cylinder.
* Smoother idle. Lean fuel mixture can be used without rough idle because of better fuel distribution and low-speed atomization.

* Lower emissions. Lean efficient air-fuel mixture reduces exhaust pollution.
* Better cold weather drivability. Injection provides better control of mixture enrichment than a carburetor.
* Increased engine power. Precise metering of fuel to each cylinder and increased air flow can result in more horsepower output.
* Fewer parts. Simpler, late model, electronic fuel injection system have fewer parts than modern computer-controlled carburetors.

There are many types of gasoline injection systems.

A basic knowledge of the different classifications：

* **single- or multi-point injection**
* **indirect or direct injection**

Single and Multipoint EFI Systems

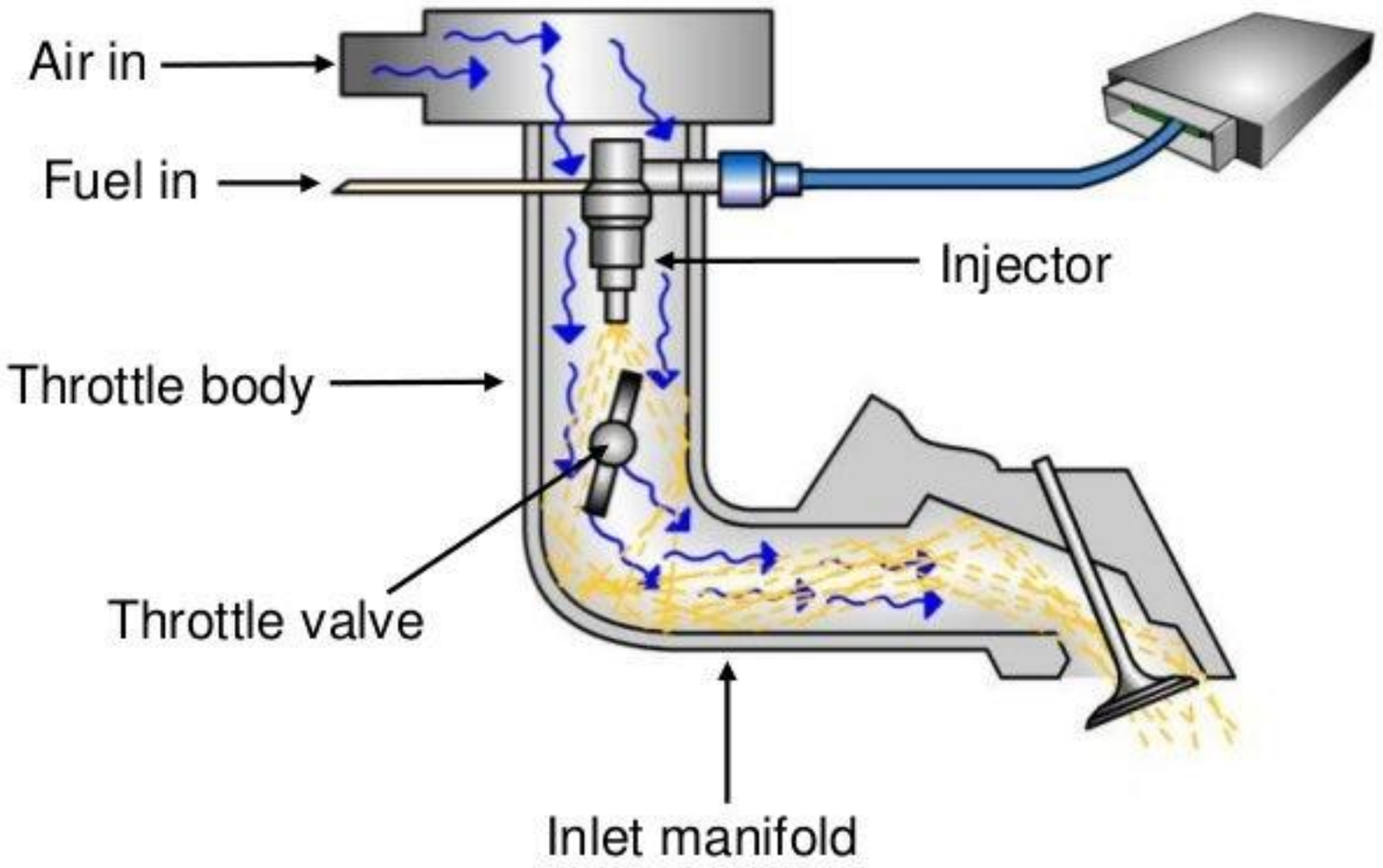
Fuel injection systems classified by point of injection.

Single Point Fuel Injection (Throttle Body Injection - TBI)

Injector located inside throttle body, sits on top of inlet manifold.

Injector sprays fuel from above throttle valve.

ECU controls injector opening.



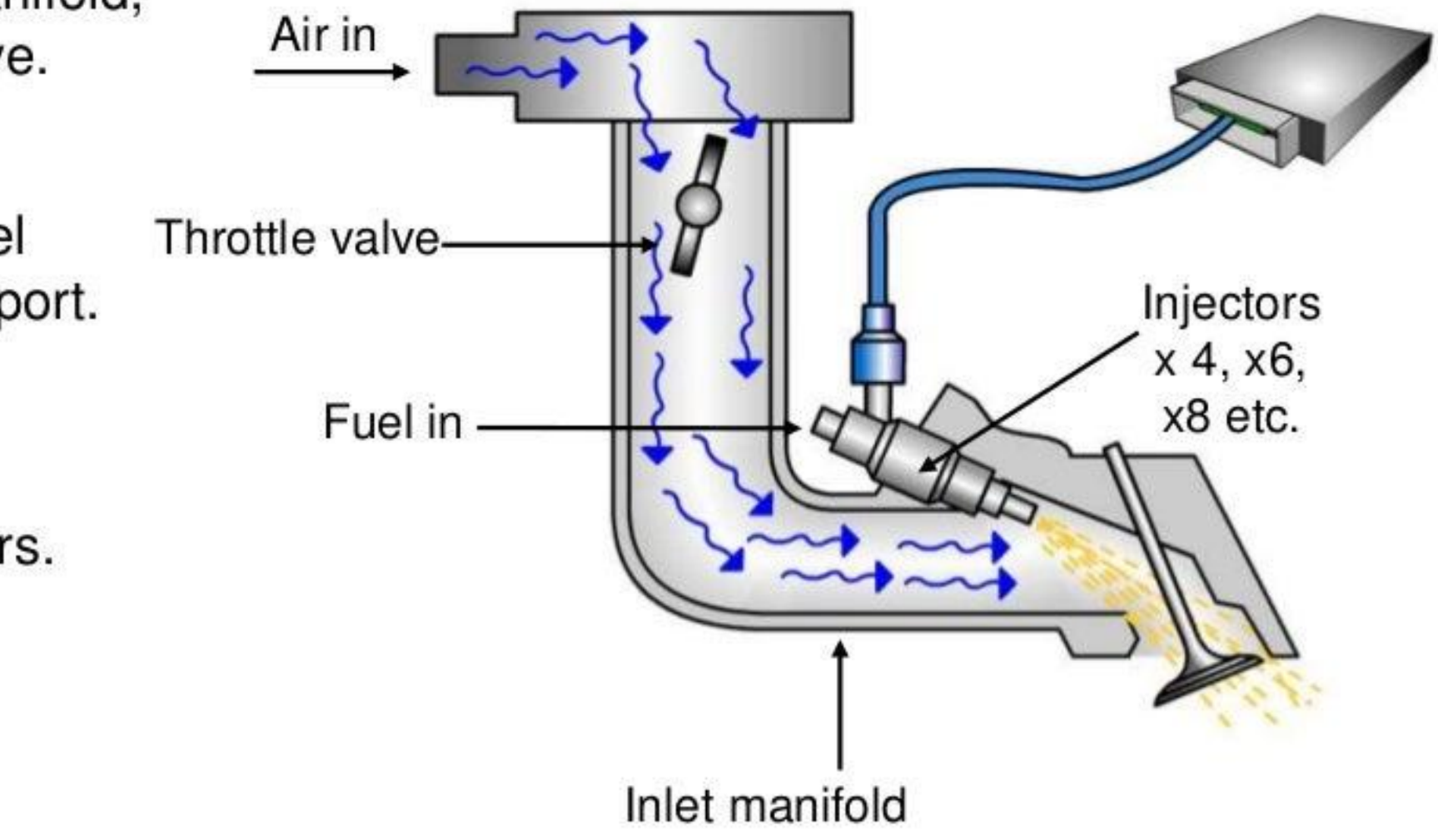
Single and Multipoint EFI Systems

Multipoint Fuel Injection

Injector located in each branch of inlet manifold, below throttle valve.

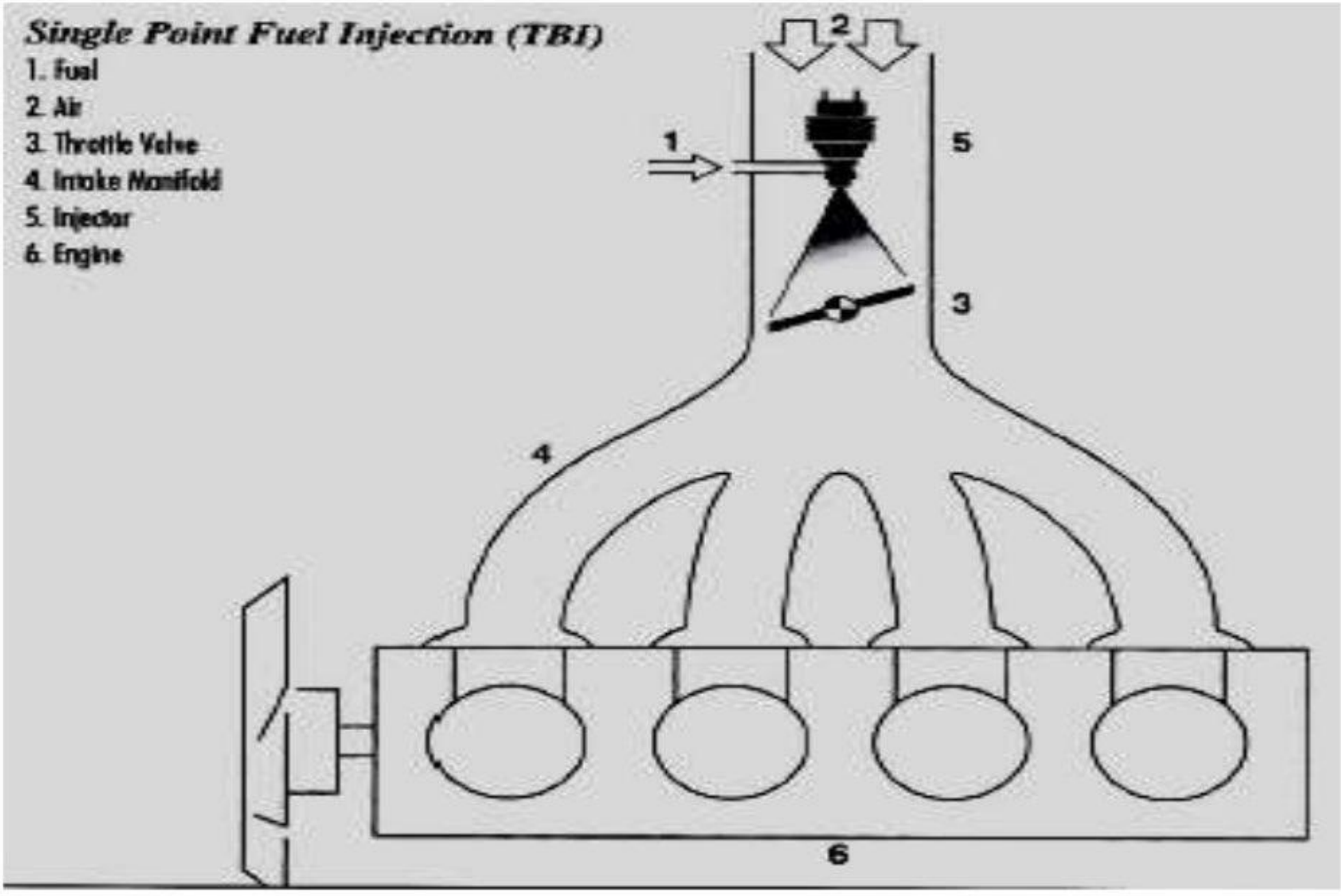
Injectors spray fuel directly into each port.

ECU controls opening of injectors.



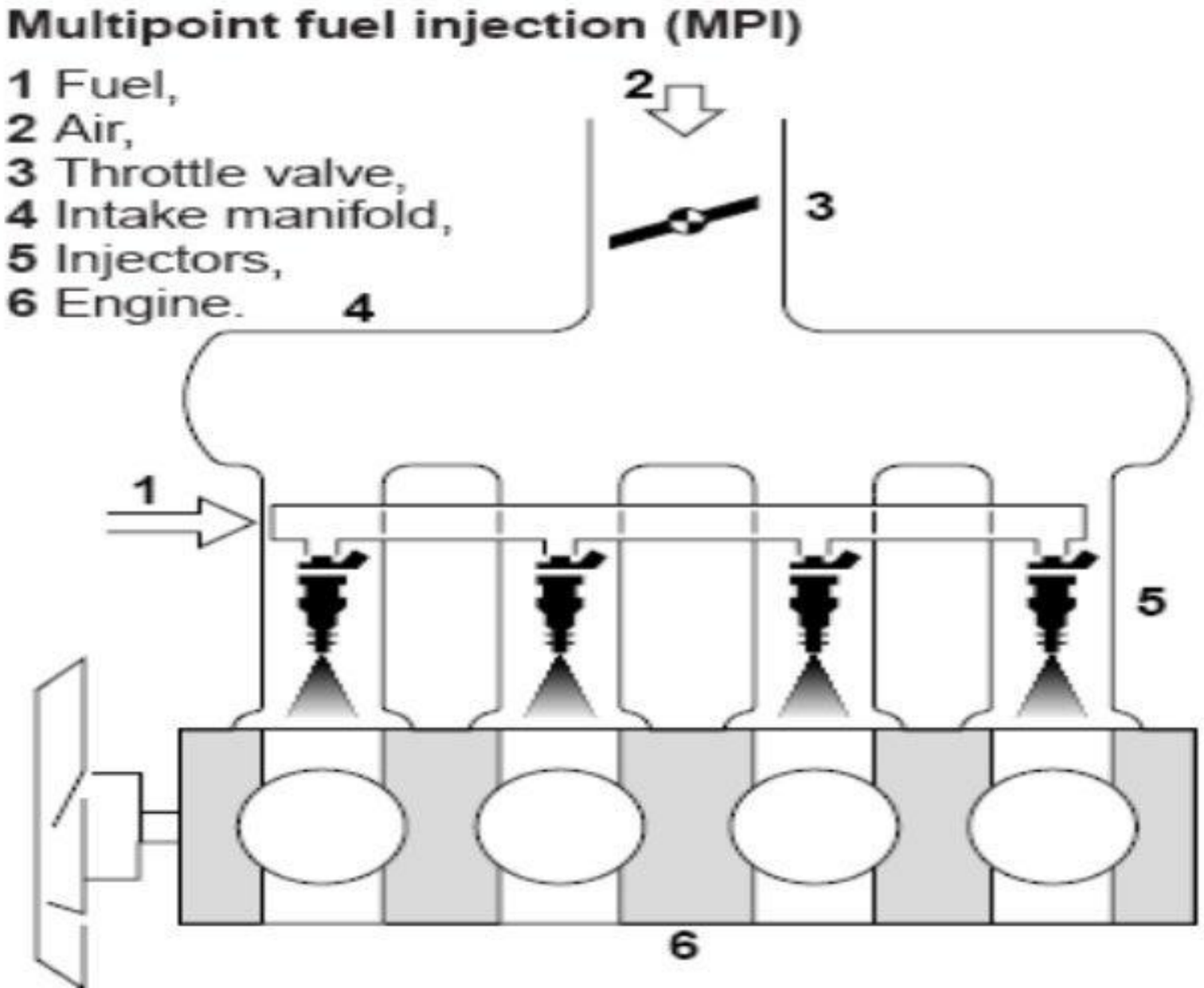
Single Point Fuel Injection (TBI)

1. Fuel
2. Air
3. Throttle Valve
4. Intake Manifold
5. Injector
6. Engine

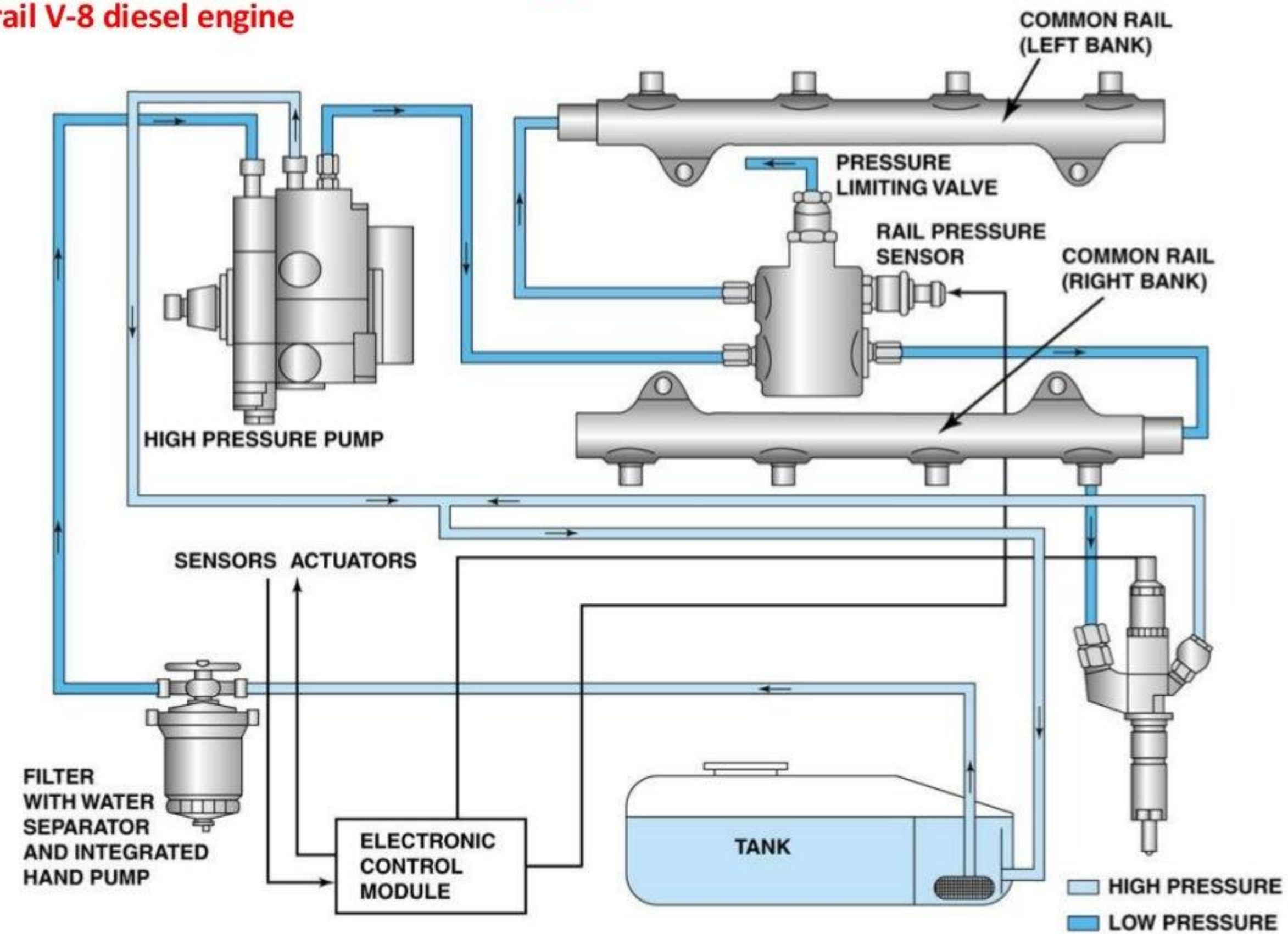


A multi-point injection system, also called port injection, has an injector in the port (air-fuel passage) going to each cylinder.

Gasoline is sprayed into each intake port and toward each intake valve. Thereby, the term multipoint (more than one location) fuel injection is used.

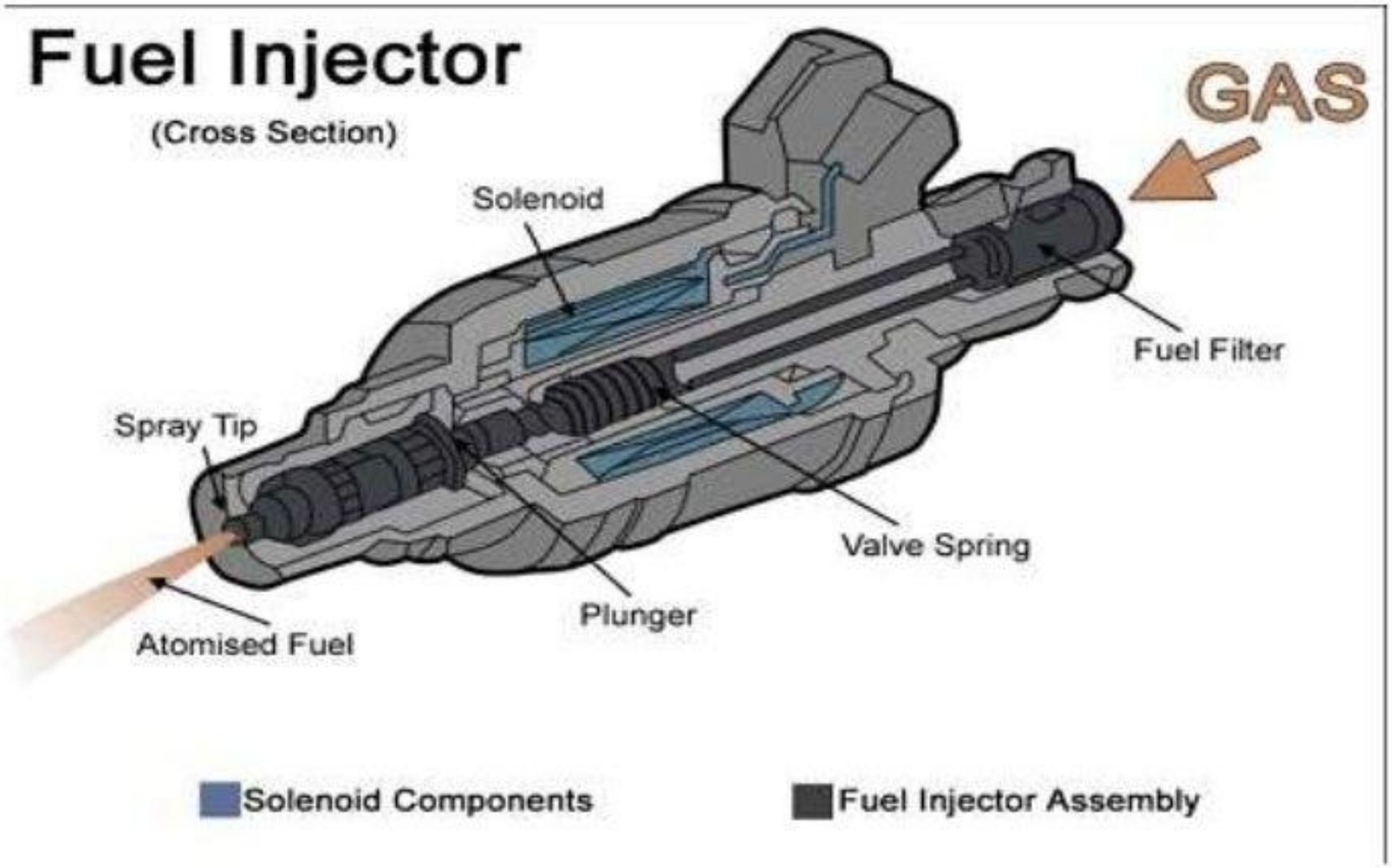


Overview of a computer-controlled high-pressure common rail V-8 diesel engine

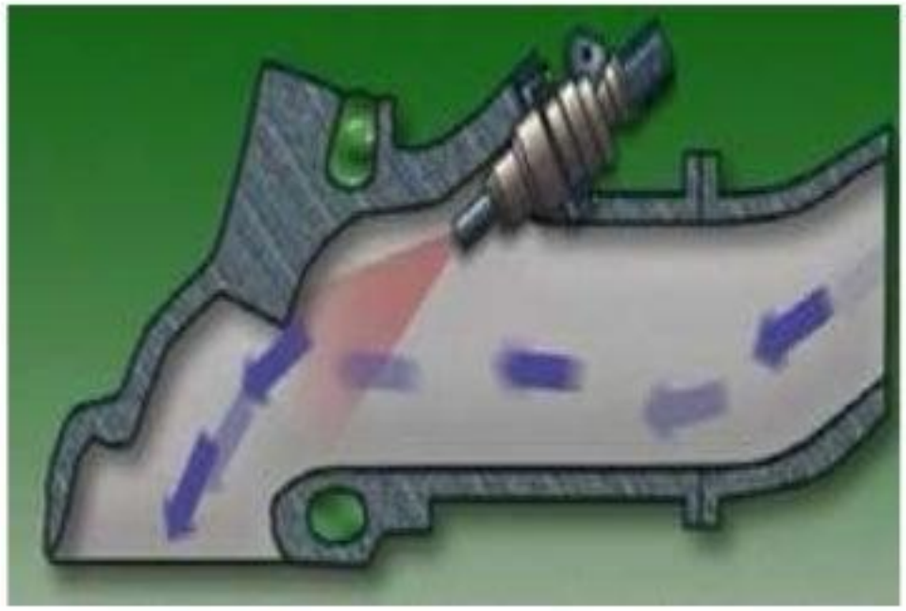


Electronic Injectors

- The injectors can survive the excessive temperature and pressure of combustion by using the fuel that passes through it as a coolant



- An indirect injection system sprays fuel into the engine intake manifold.
  Most gasoline injection systems are of this type.
- Direct injection forces fuel into the engine combustion chambers. Diesel injection systems are direct type.



So Gasoline electronic Direct Injection System is Classified as : multi-point and Direct injection systems

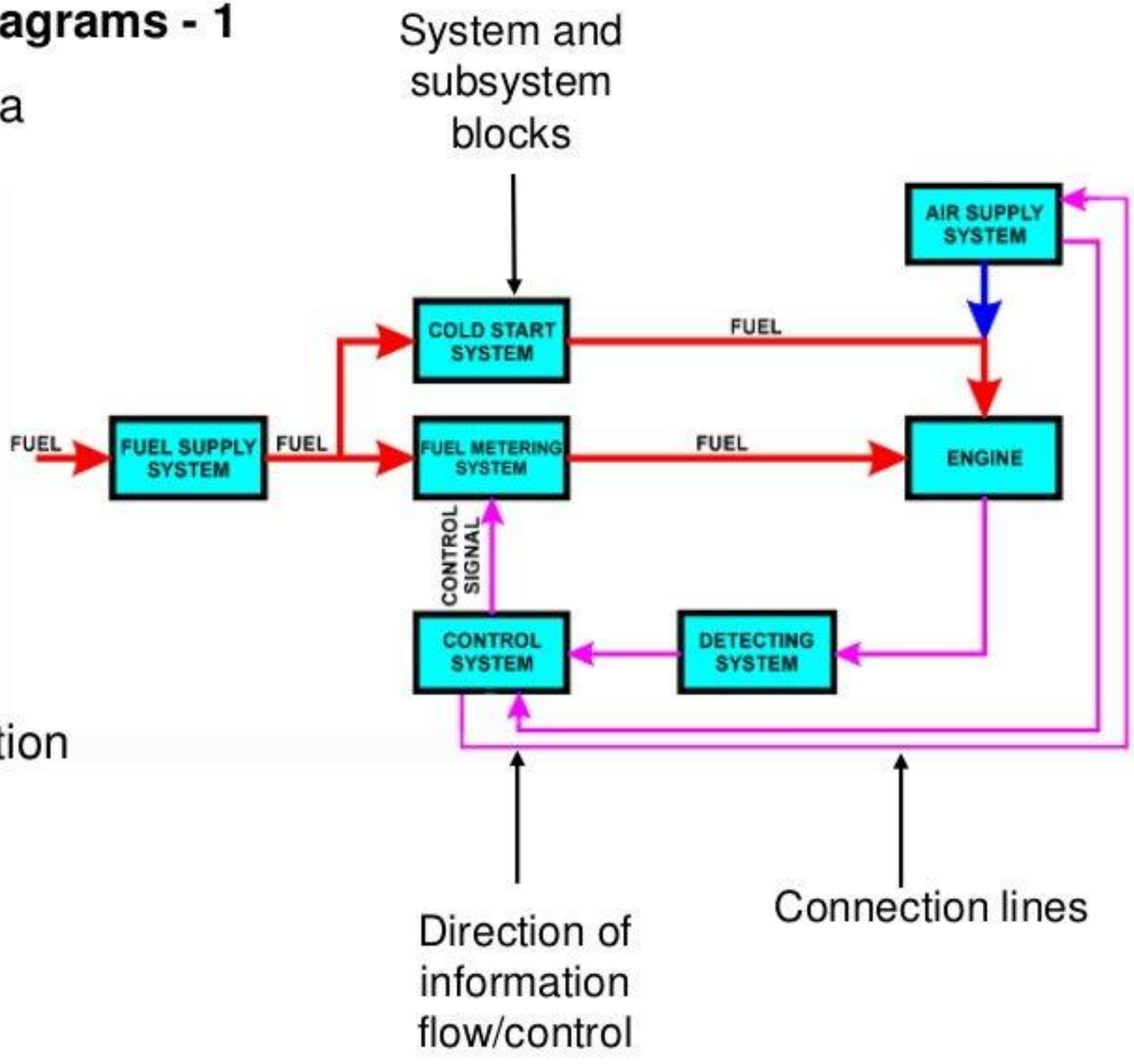
Fuel System Diagrams and Schematics

Fuel System Block Diagrams - 1

Each block represents a system.

Lines represent connections between systems.

Arrows represent direction of flow.

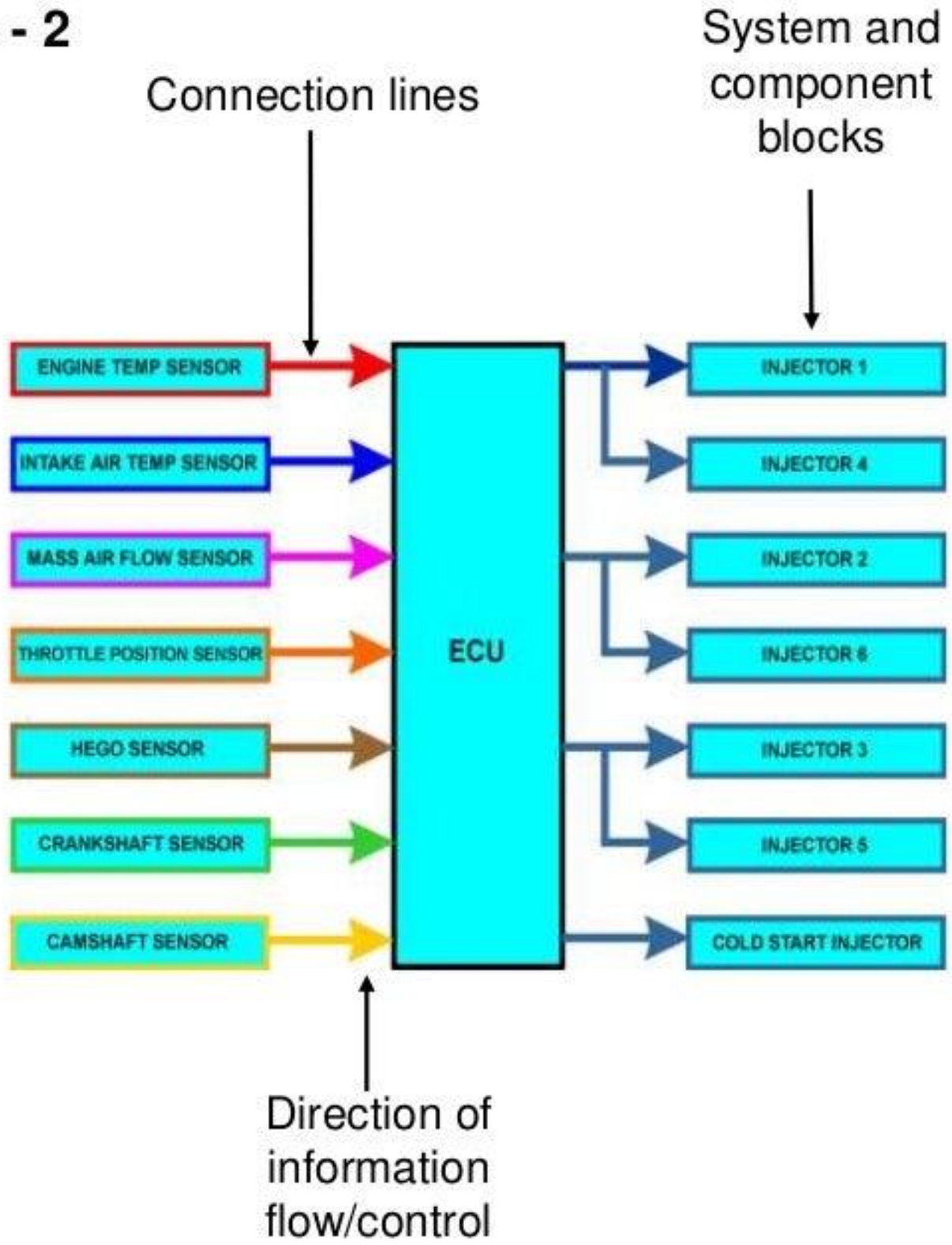


Fuel System Block Diagrams - 2

Each block represents a component.

Lines represent connections between systems.

Arrows represent direction of flow.



Electronic control unit

- In automotive electronics, **electronic control unit** (**ECU**) is a generic term for any embedded system that controls one or more of the electrical systems or subsystems in a motor vehicle.
- An **engine control unit (ECU)**, also known as **power-train control module (PCM)**, or **engine control module (ECM)** is a type of electronic control unit that determines the amount of fuel, ignition timing and other parameters an internal combustion engine needs to keep running. It does this by reading values from multidimensional maps which contain values calculated by sensor devices monitoring the engine.

Working of ECU

Control of fuel injection: ECU will determine the quantity of fuel to inject based on a number of parameters. If the throttle pedal is pressed further down, this will open the throttle body and allow more air to be pulled into the engine. The ECU will inject more fuel according to how much air is passing into the engine. If the engine has not warmed up yet, more fuel will be injected .

Control of ignition timing : A spark ignition engine requires a spark to initiate combustion in the combustion chamber. An ECU can adjust the exact timing of the spark (called ignition timing) to provide better power and economy.

- **Control of idle speed :** Most engine systems have idle speed control built into the ECU. The engine RPM is monitored by the crankshaft position sensor which plays a primary role in the engine timing functions for fuel injection, spark events, and valve timing. Idle speed is controlled by a programmable throttle stop or an idle air bypass control stepper motor.

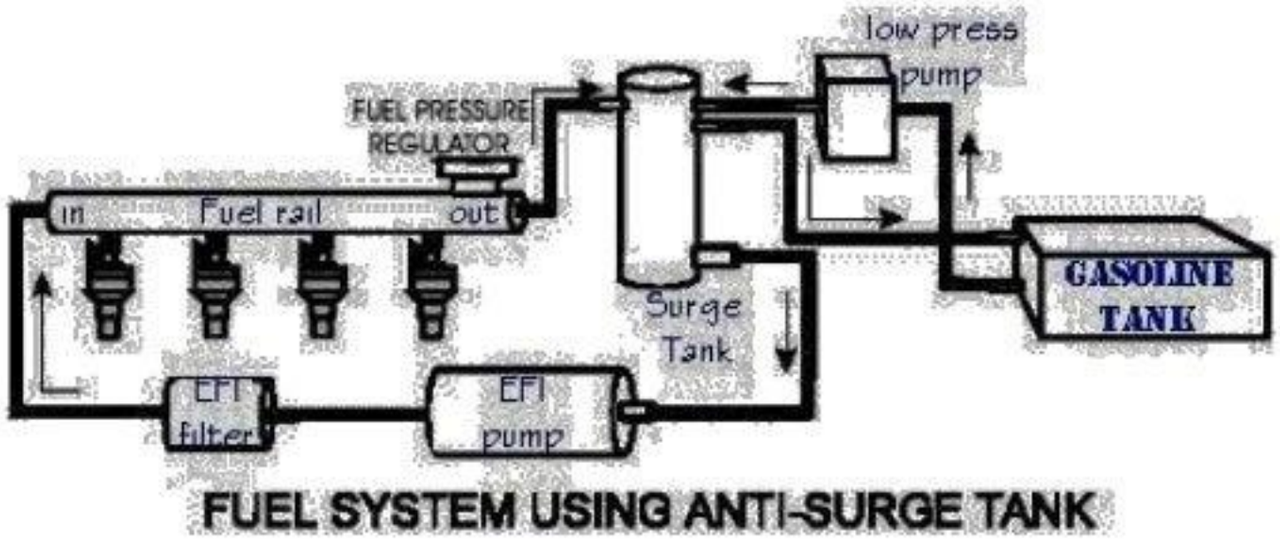
Common rail and Pressure sensor

The term "common rail" refers to the fact that all of the fuel injectors are supplied by a common fuel rail which is nothing more than a pressure accumulator where the fuel is stored at high pressure. This accumulator supplies multiple fuel injectors with high pressure fuel.

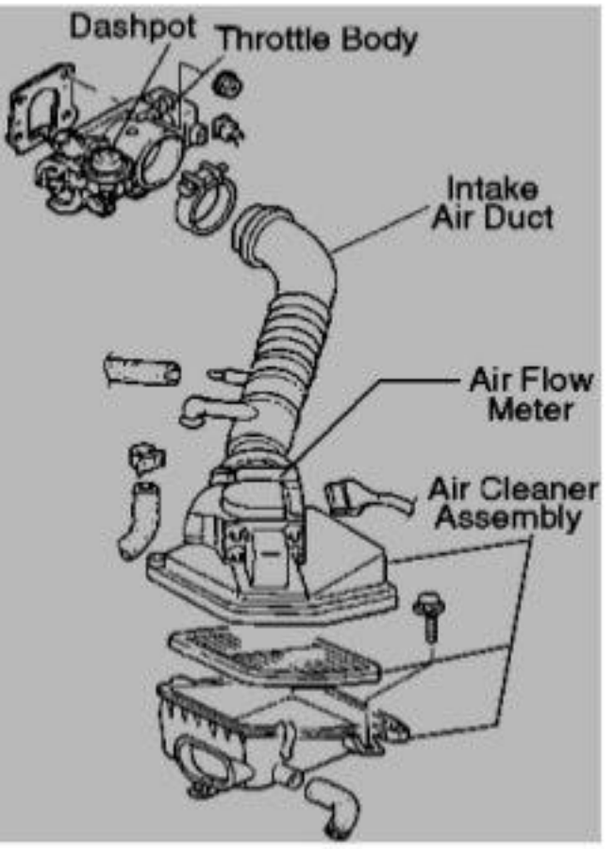
Fuel Injection System

Electronic Fuel Injection uses various engine sensors and control module to regulate the opening and closing of injector valve.

•Fuel delivery system

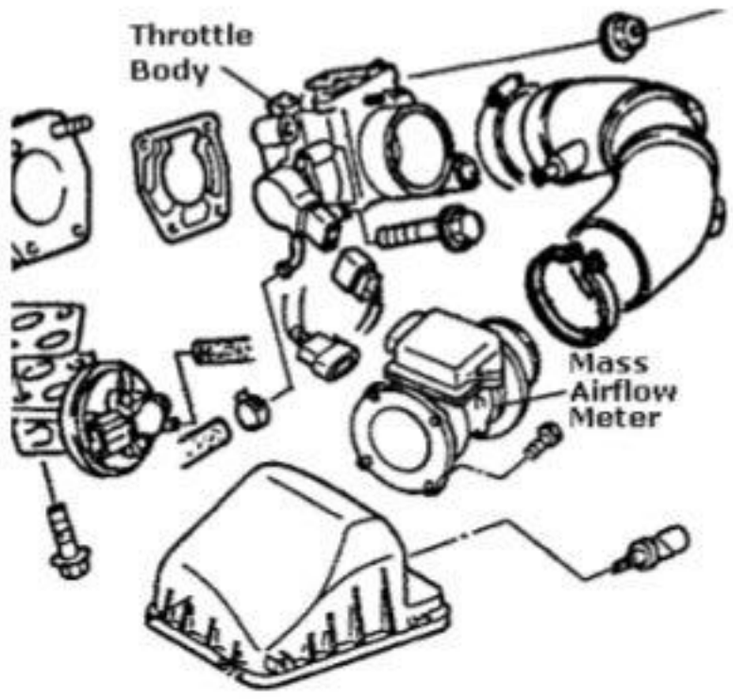


FUEL SYSTEM USING ANTI-SURGE TANK



•Sensor system

•Air induction system



•Computer control system