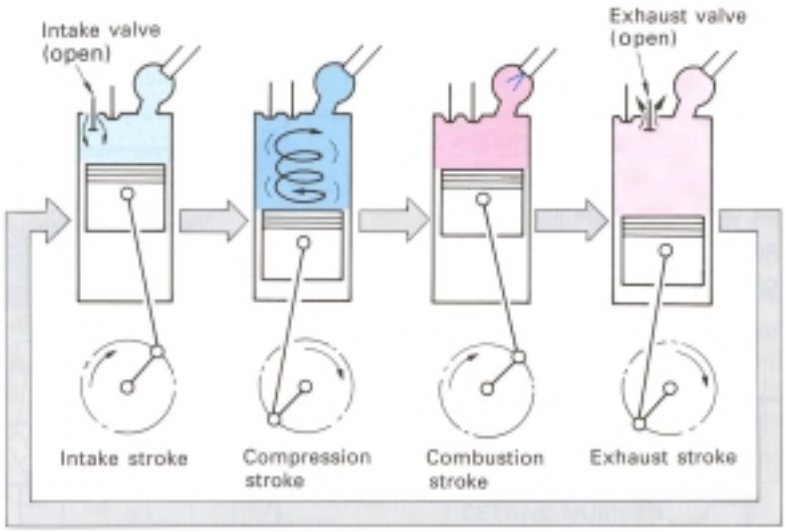
TECHNICAL INFORMATION – DIESEL FUEL INJECTION

PRINCIPLE OF 4 STROKE DIESEL ENGINE

All diesel engines mounted on automobiles are generally four-stroke engines.
A four-stroke engine operates by a constant repetition of the sequence:

1) Intake stroke
2) Compression stroke
3) Combustion (power) stroke
4) Exhaust stroke

Principle of 4 stroke diesel engine



PRINCIPLE OF 4-STROKE DIESEL ENGINE

A COMPARISON OF THE PETROL ENGINE & DIESEL ENGINE DURING EACH STROKE

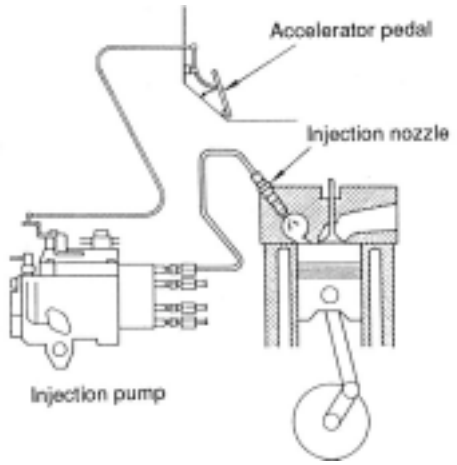
ENGINE / Stroke	PETROL ENGINE	DIESEL ENGINE
Intake	Air-fuel mixture is drawn into combustion chamber by vacuum.	Air only is drawn in
Compression	Piston compresses air-fuel mixture	Piston compresses air to increase both pressure to approx. 30 kg/cm^2 (427 psi, 2,042 kPa) and temperature to approx. 500-800^{0}C .
Combustion	Spark plug ignites compressed mixture	Fuel is injected into heated, highly compressed air, where it ignites due to heat of pressurised air.
Exhaust	Piston forces exhaust gases out of cylinder	Piston forces exhaust gases out of cylinder.

Diesel Engine Output Control

In a diesel engine, fuel is injected into air which is heated to a high temperature by being strongly compressed. This causes it to ignite and burn. To obtain a high compression pressure, a large amount of air is drawn into the cylinders.

Therefore, in a diesel engine, engine output is controlled by controlling the amount of fuel injected.

Diesel Engine



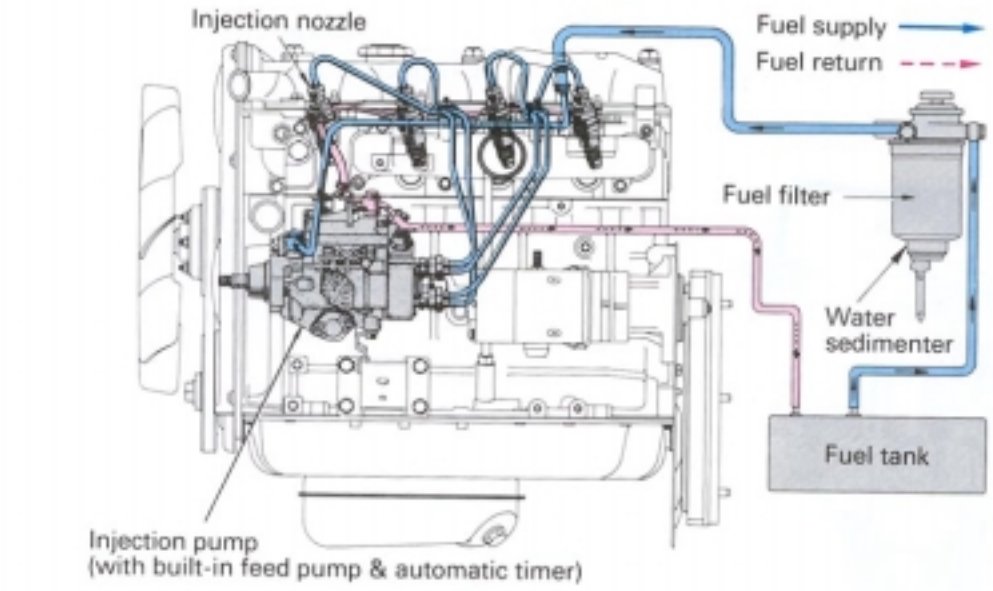
FUEL INJECTION SYSTEM

Description

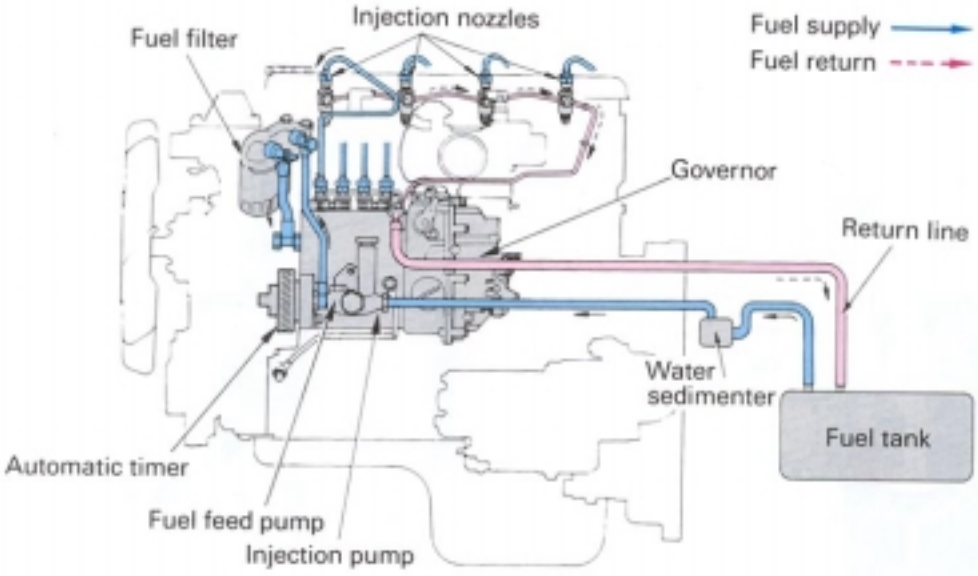
The diesel engine fuel system consists of the parts shown below.
Because the diesel injection system (injection pump and nozzles) is extremely sensitive to the presence of any water in the fuel, it is critical that water does not reach these components.

Also, because clearance between operating parts in the injection pump and nozzles is extremely small; any contamination resulting from water, rust or dirt will cause these parts to fail.

To keep the fuel supply system as free from dirt and moisture as possible, the water sedimeter and fuel filter must be properly maintained.



VE TYPE INJECTION PUMP FUEL SYSTEM



IN-LINE TYPE INJECTION PUMP FUEL SYSTEM

CLASSIFICATION OF DIESEL FUEL INJECTION PUMPS

In a diesel engine fuel injection system for automobiles and industrial machines, a pump, which injects fuel with a plunger, is generally used. This type of pump is classified as follows.

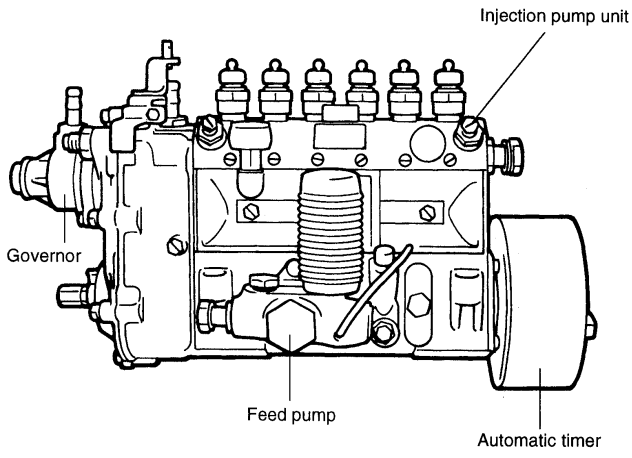
In line type pump	The same number of plungers as engine cylinders are aligned in series in the pump
Distributor type pump	One plunger distributes fuel into each cylinder
Camshaft-less type pump	Same as the in-line type pump, the camshaft-less (PFR) type pump does not have a camshaft.

CHARACTERISTICS & PURPOSE OF EACH TYPE OF PUMP

a. In Line Type Fuel Injection Pump

Consists of pump main body, governor, feed pump and timer. It has the same number of plungers as cylinders of the engine and supplies fuel to all cylinders with one rotation of the camshaft.

As this type of pump has the longest history of usage, it is widely used. It is now common in middle and large size trucks, agricultural machines and construction machines, while the distributor type is taking over for small engines.

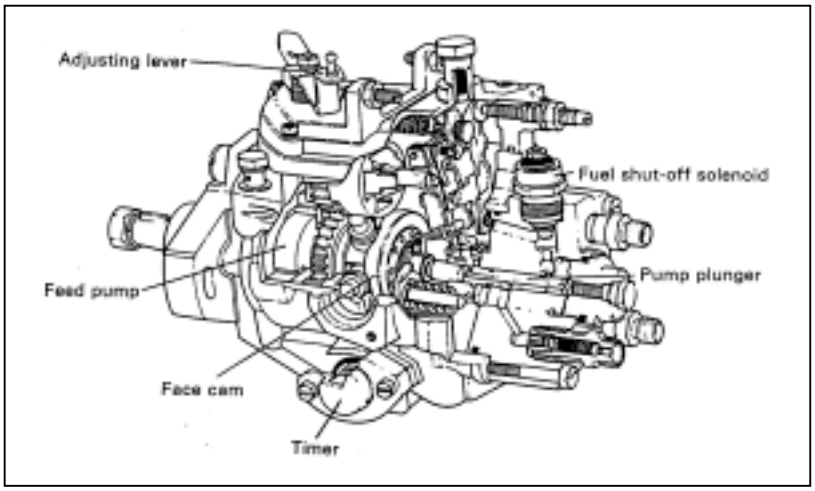


In-line type injection pump

b. The Distributor Type Fuel Injection Pump (VE Type)

The distributor type pump was developed in response to the demand for lighter, more compact pumps for the smaller car engines now available.

This type of pump injects and distributes the fuel into each cylinder with one rotation of a plunger. Because components such as governors, feed pump and timer are built into the pump body, this pump is suited to mass production.

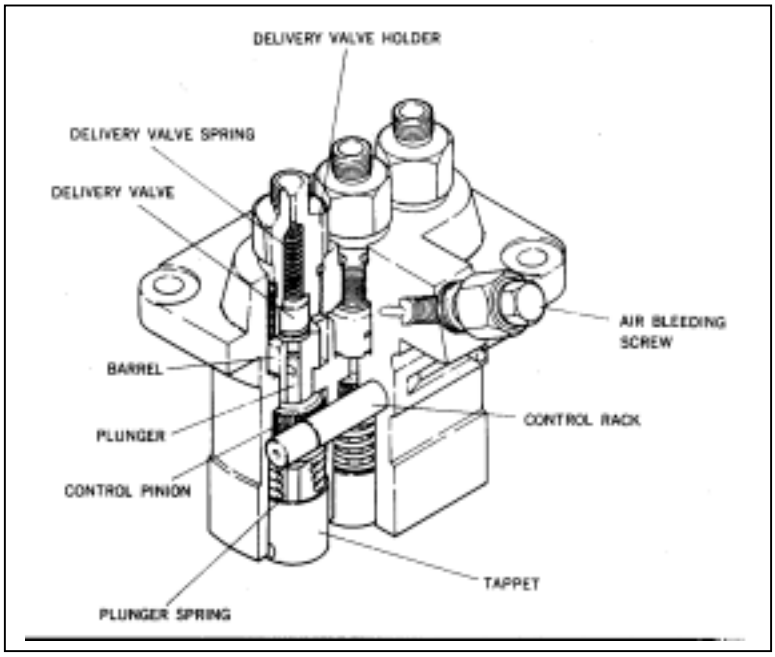


c. Camshaft-Less (PFR) Type Fuel Injection Pump

The principle behind the PFR type and In-Line type pump is the same.

However, in the PFR type, the camshaft and governor function are on the engine side for a more compact system.

This type of pump is used for agricultural machines and construction machines that require simple control.



Current pump type in Australia:

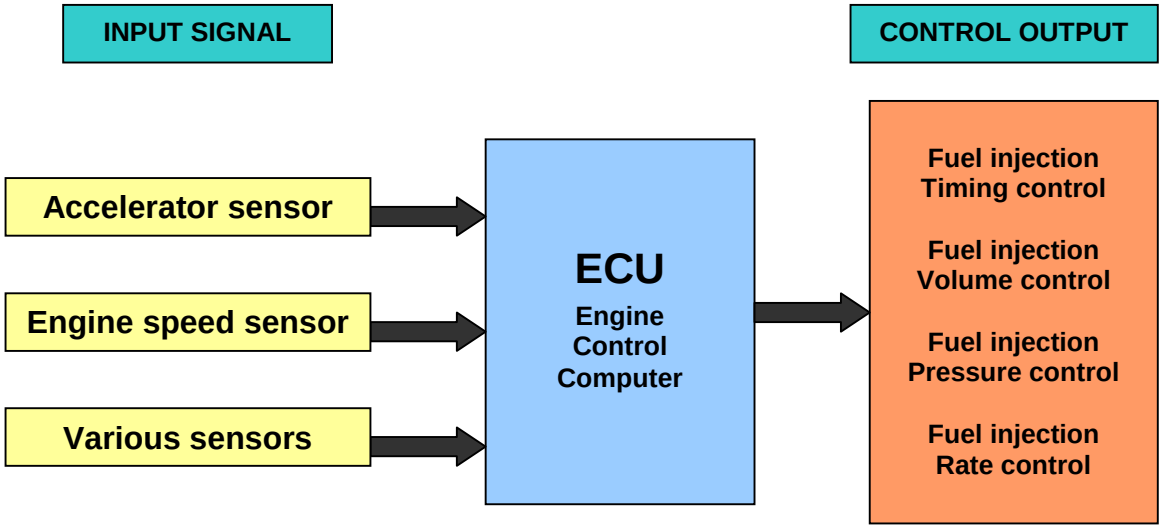
DISTRIBUTOR TYPE FUEL INJECTION PUMP – ELECTRONICALLY CONTROLLED – OVERVIEW

The electronic control system of the distributor type pump consists of various sensors, an ECU (computer) and actuators. The DENSO DFI pumps commonly used in Australia at present are the ECD-V3 and ECD-V4 which are both electronically controlled distributor types.

Sensors detect the running condition of the engine or pump

The **ECU** (Electronic Control Unit) receives input signals from various sensors and then calculates and controls the output signals for factors such as timing, volume and pressure.

Actuators control injection quantity and injection timing according to the signal sent from the ECU.



……The way of the future

COMMON RAIL TYPE FUEL INJECTION PUMP – ELECTRONIC CONTROL

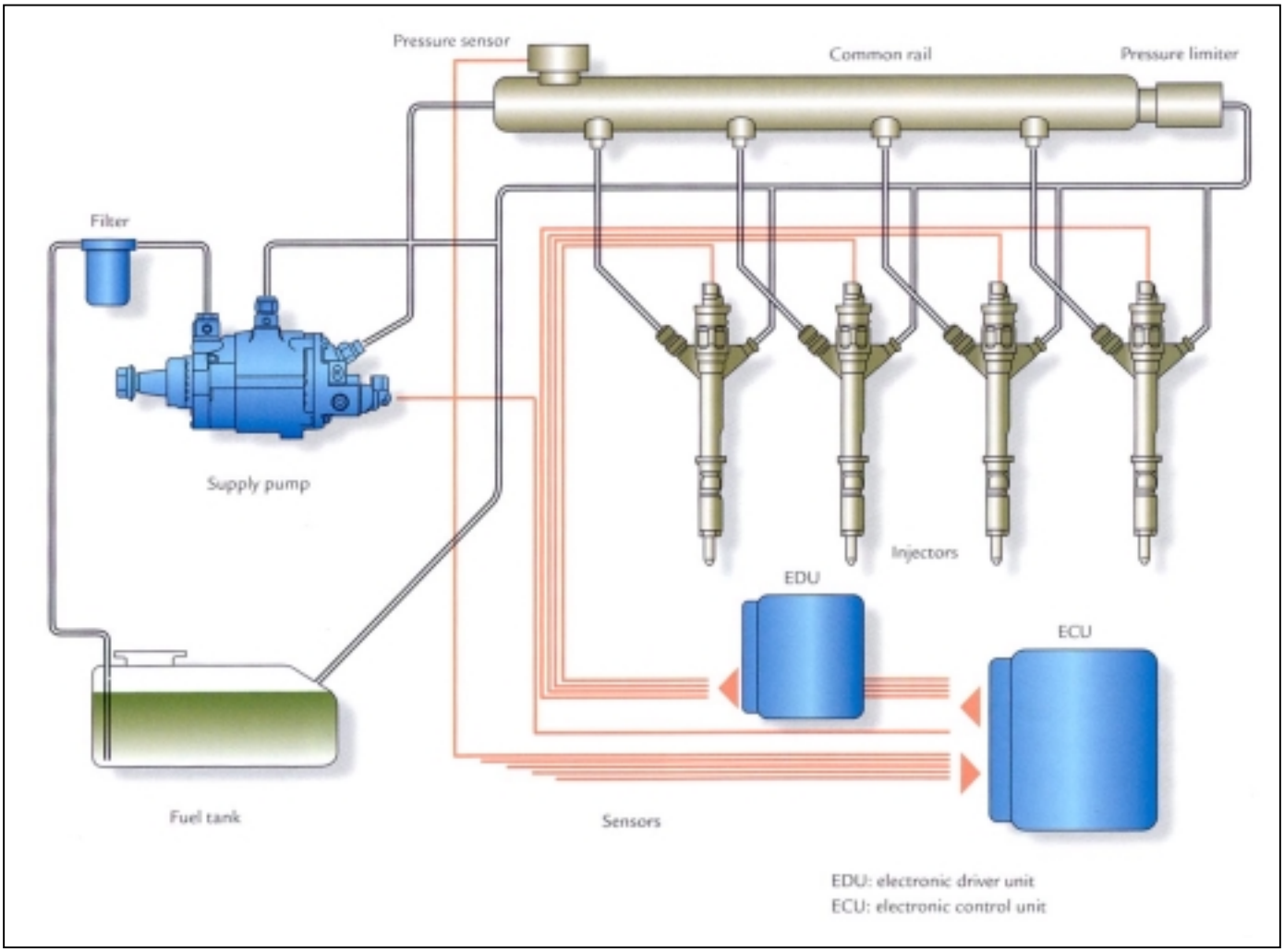
Increasingly stringent emission regulations will be impossible to meet with conventional diesel systems. With their greater accuracy and reduced emissions, Common rail injection systems will be instrumental in engineering diesel engines that will comply with future emission regulations.

Injection parameters are very important for diesel power. Injection pressure is much higher, with multiple, precisely controlled injections at each combustion stroke. With common rail technology, the quantity, timing and pressure of injections are controllable separately. This allows for more precise fine-tuning of engine performance than with petrol systems.

The common rail type system is completely different than conventional fuel injection pumps. With previous pumps, fuel is distributed from the high pressure pipe to each cylinder. With this system, high pressure fuel is accumulated at a common rail. This eliminates the need for a fuel force-feed system based on the number of cylinders.

The supply pump draws the fuel up from the tank for force-feeding to the common rail, until the required common rail pressure is reached. An injector mounted on each cylinder then distributes the high-pressure fuel to each injector via the common rail. The ECU controls fuel delivery timing and amount.

Common Rail fuel system



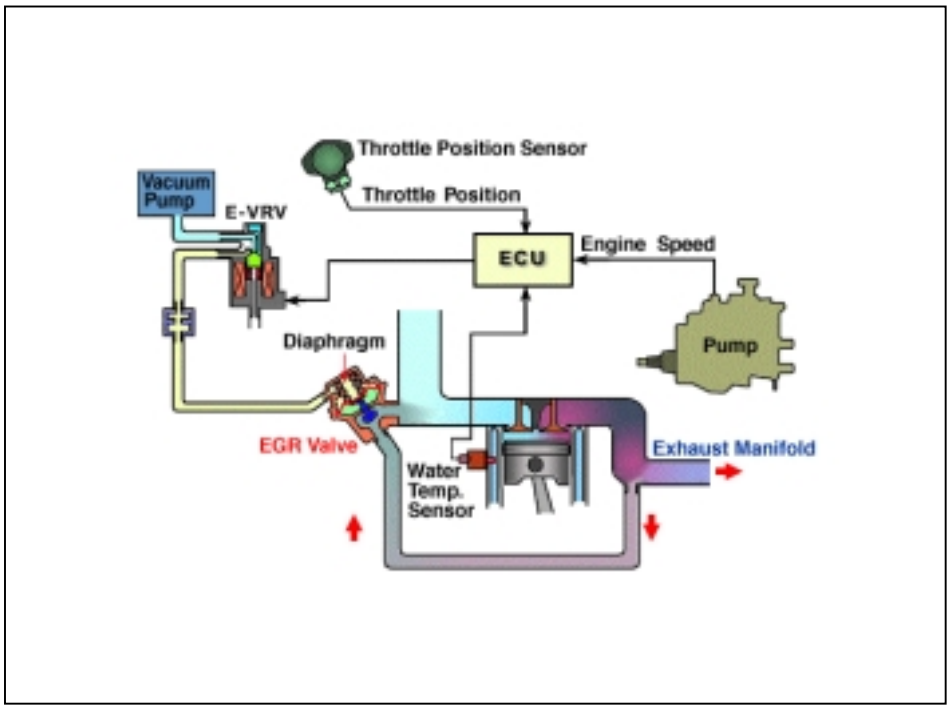
GLOSSARY

EDU (Electronic Driving Unit)

CDI type high voltage driver. It is used for high speed driving of the electromagnetic spill valve that works under high pressure. The EDU allows precise control of the injection timing of highly pressurised and finely atomised fuel which decreases emissions.

EGR Control

Controls exhaust gas by recirculating it into the gas intake manifold to suppress combustion and therefore reduce emissions (NOx).



Governor

Automatically controls the engine speed and output by adjusting the fuel injection quantity in accordance with the load on the engine, and the amount that the accelerator pedal is depressed.

SPV – Solenoid Spill Valve

Highly pressure resistant and responsive, the solenoid spill valve is a direct-acting solenoid valve that controls the injection volume. When the solenoid spill valve opens, the highly pressurised fuel in the plunger returns to the pump chamber, ending the injection of fuel.