

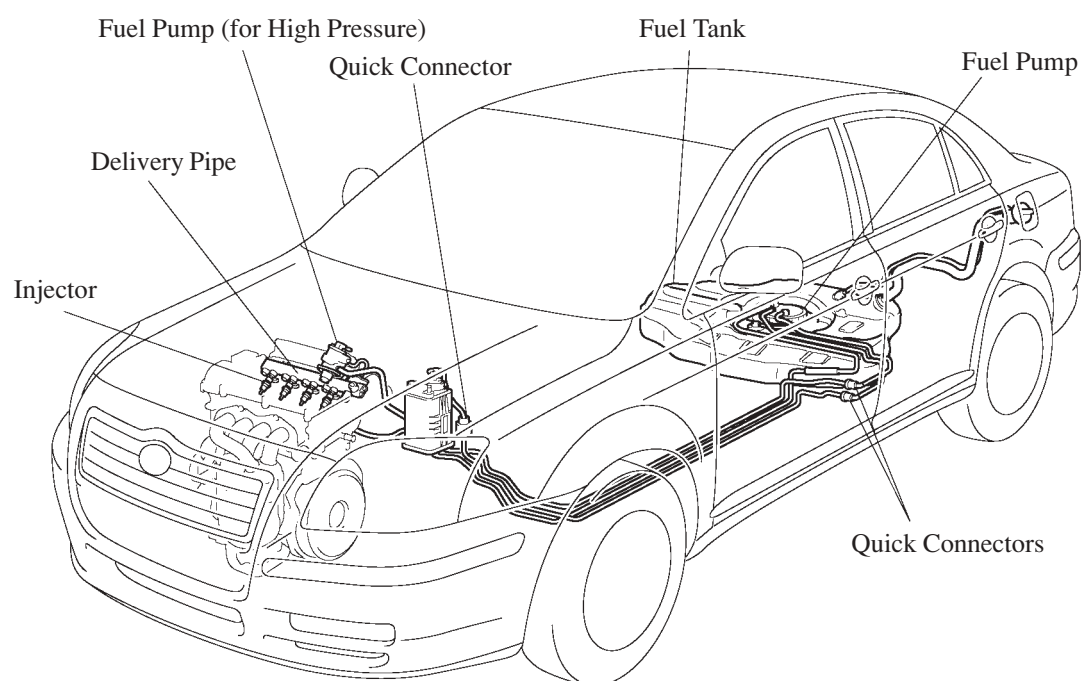
3) TWC (Three-way Catalytic Converter)

A ceramic type TWC has been adopted. This TWC enables to improve exhaust emissions by optimizing the cells density and the wall thickness.

9. Fuel System

1) General

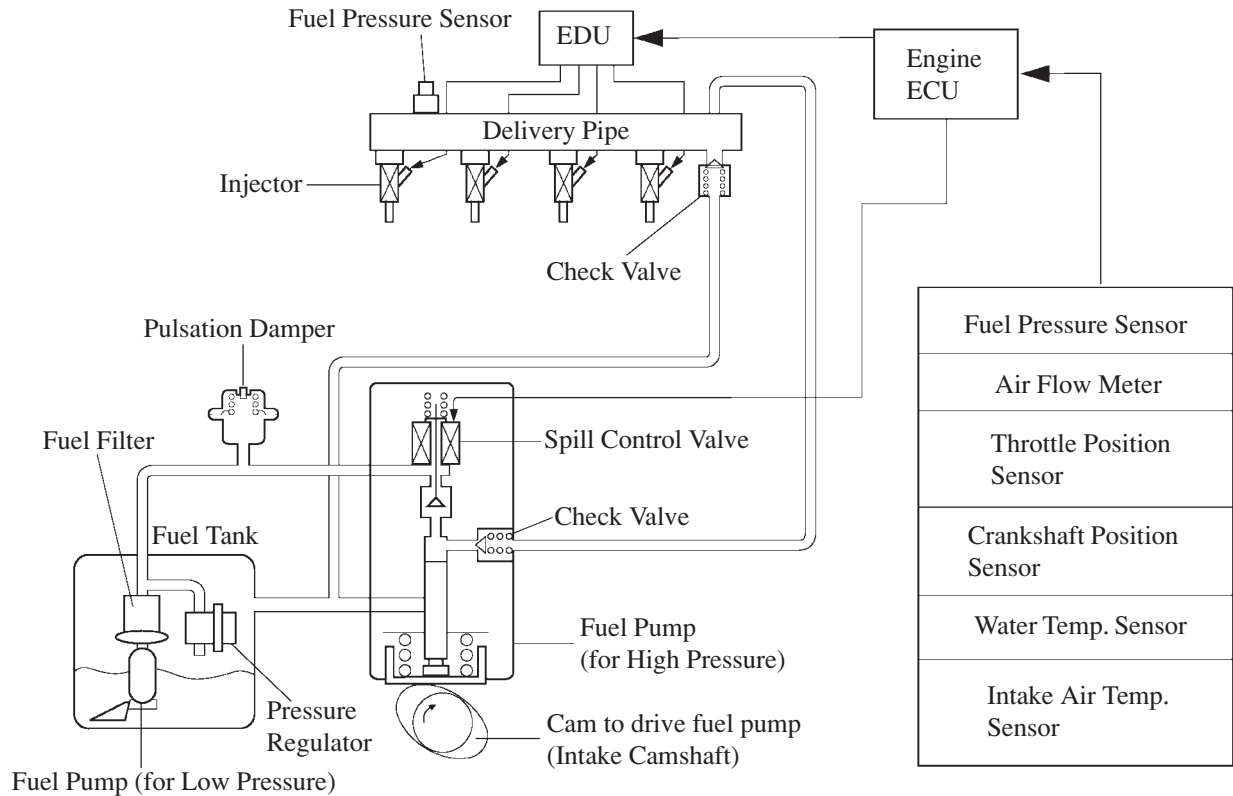
- A direct injection system used in the fuel system of the 2AZ-FSE engine. This system consists of a fuel pump (for high pressure), delivery pipe, and slit nozzle type injectors.
- A fuel cut control is used to stop the fuel pump when the SRS airbag is deployed in a front or side collision.
- A quick connector is used to connect the fuel pipe with the fuel hose to improve serviceability.



2) Direct Injection System

- Mainly consisting of a fuel pump (high pressure), delivery pipe, and slit nozzle type injectors, this system effects optimal control for combustion by controlling the fuel pressure, injection volume, and the injection timing via the engine ECU and EDU (Electronic Driver Unit).

► System Diagram ◀



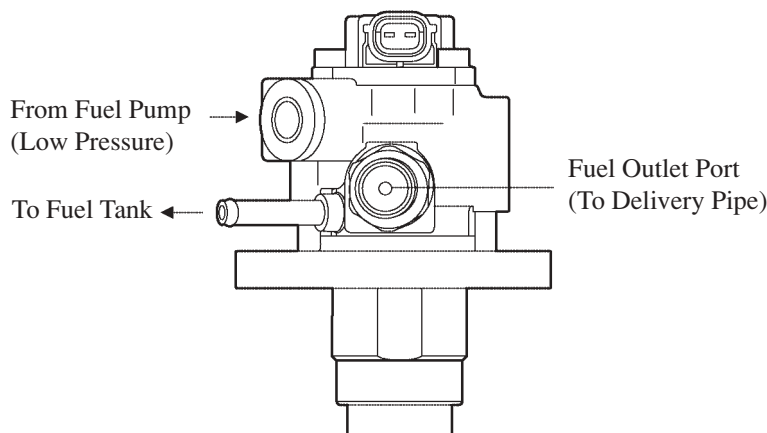
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- The direct injection system for the 2AZ-FSE has following components and functions.

Component	Outline
Fuel Pump (for High Pressure)	To pressurize the fuel from the fuel pump (for low pressure) from 8 to 13 MPa and send it to the delivery pipe.
Delivery Pipe	To deliver the high pressure fuel to the injector.
Fuel Pressure Sensor	The fuel pressure sensor senses the fuel pressure and outputs the signal to the engine ECU.
Relief Valve	When the pressure in the delivery pipe is abnormally high, the relief valve leaks the fuel to the fuel tank to reduce pressure.
Injector	To adjust the quantity of the high pressure fuel and inject the fuel directly into the combustion chamber.
EDU (Electronic Driver Unit)	The EDU drives the injector at high speed.
Engine ECU	Depending on the vehicle condition, and based on the signal from each sensor, calculate the optimized injection timing and injection volume, and control the injector and fuel pump (for high pressure).

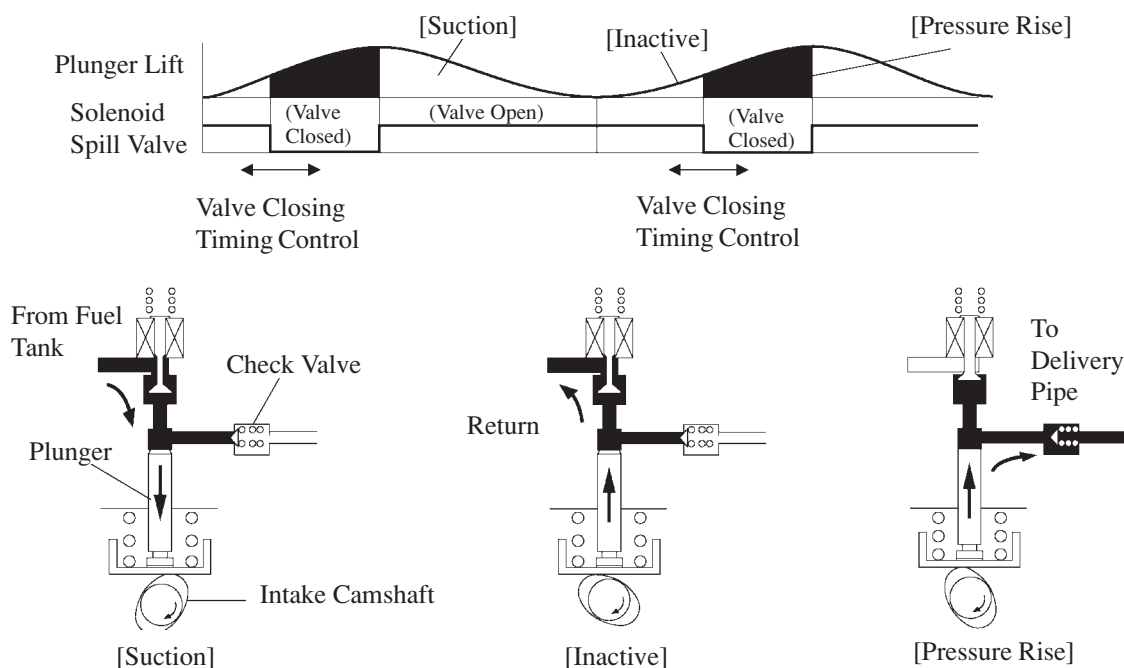
3) Fuel Pump (for High Pressure)

- Fuel pump consists of a plunger, spill control valve, and check valve. The plunger moves up and down by a pump driving cam (2 waves) of the intake camshaft. The spill control valve is established in the inlet pass of the pump, and electrically opens and closes the valve by a signal from the engine ECU and controls the pump discharging pressure. A check valve is equipped in the outlet of the pump, and it opens the valve when the fuel pressure in the pump has becomes 60 kPa and discharges the fuel to the delivery pipe.



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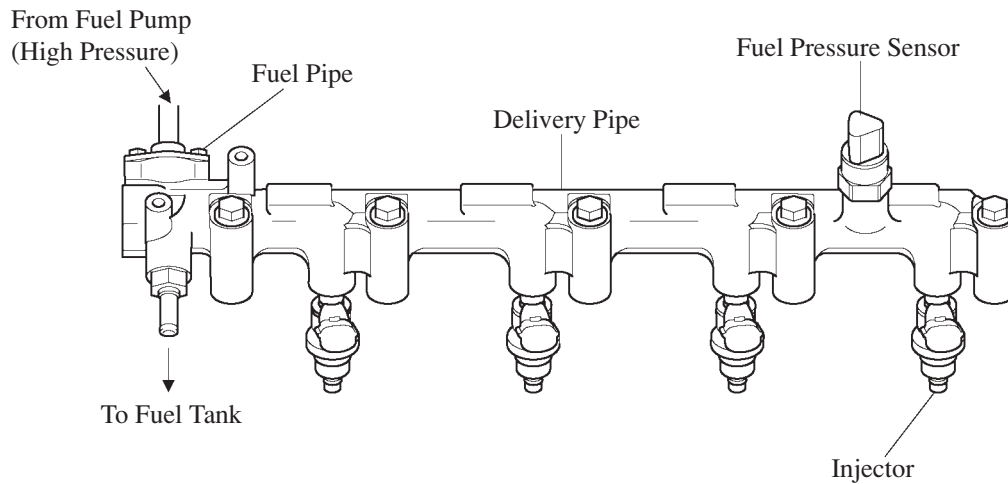
- In the suctioning process of the pump, the spill control valve opens and the plunger strokes downward by a spring force, and the fuel is suctioned into the cylinder. Then, by the action of the cam, the plunger strokes upward, but at this time the spill control valve has not closed yet, so the part of the fuel in the cylinder is pushed back to the fuel tank side (while it is not pressurized). On the way in which the plunger is stroking upward (in the compressed process), the engine ECU closes the spill control valve and rise the fuel pressure in the cylinder. When the fuel pressure in the cylinder has exceeded 60 kPa, the check valve starts to open and discharged the fuel to the delivery pipe. The engine ECU controls the fuel discharging pressure from 8 to 13 MPa depending on the driving condition by controlling the timing to close the spill control valve valiantly.



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4) Delivery Pipe

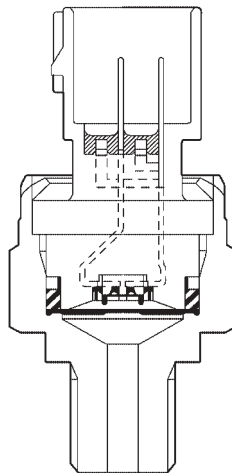
- A delivery pipe made of aluminum die-casting is adopted. On the delivery pipe, injectors, fuel pressure sensor, and relief valve are directly installed. By storing fuel at a high-pressure (8 to 13 MPa), the peak torque during the pumping of fuel under high load conditions has been restrained, thus reducing the vibration and noise of the fuel injection system.



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5) Fuel Pressure Sensor

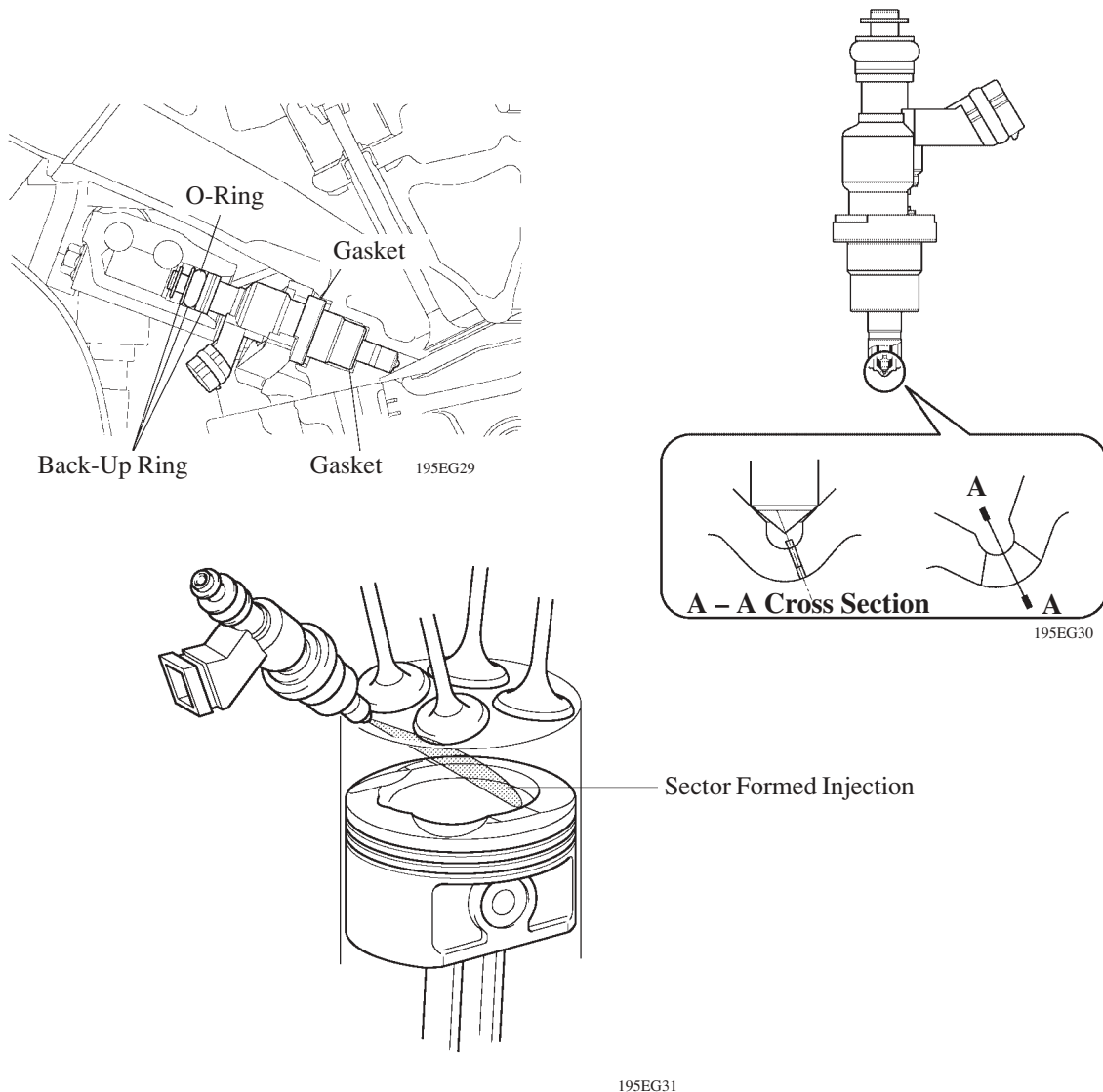
- The fuel pressure sensor, which is mounted on the delivery pipe, outputs a signal that represents the fuel pressure in the delivery pipe to the engine ECU in order to constantly regulate the fuel at an optimal pressure.



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6) Injector

- High-pressure, slit-nozzle type injectors are used in conjunction with the adoption of the TOYOTA D-4 (Direct injection, 4-stroke gasoline engine). The injectors are secured to the cylinder head by way of a clamp, and the gaskets are used to seal the combustion gas in the cylinder. In addition, an O-ring and the back-up rings are used to seal the fuel and to reduce noise. And the nozzle hole has been coated to restrain the adhesion of deposits. The injectors, based on a signal from the engine ECU, adjusts the flow of the high pressure fuel and injects the fine-grain sector formed fuel directly to the combustion chamber by a slit nozzle. The injectors are actuated under high-voltage and constant-current control by the EDU in order to inject high-pressure fuel in a short time.



7) EDU (Electronic Driver Unit)

- The EDU is used to drive the injector at high speeds. The EDU has realized high-speed driving under high fuel pressure conditions through the use of a DC/DC converter that provides a high-voltage (The voltage increases from 12V to 175V), quick-charging system.
- The engine ECU constantly monitors the EDU and stops the engine in case an abnormal condition is detected.