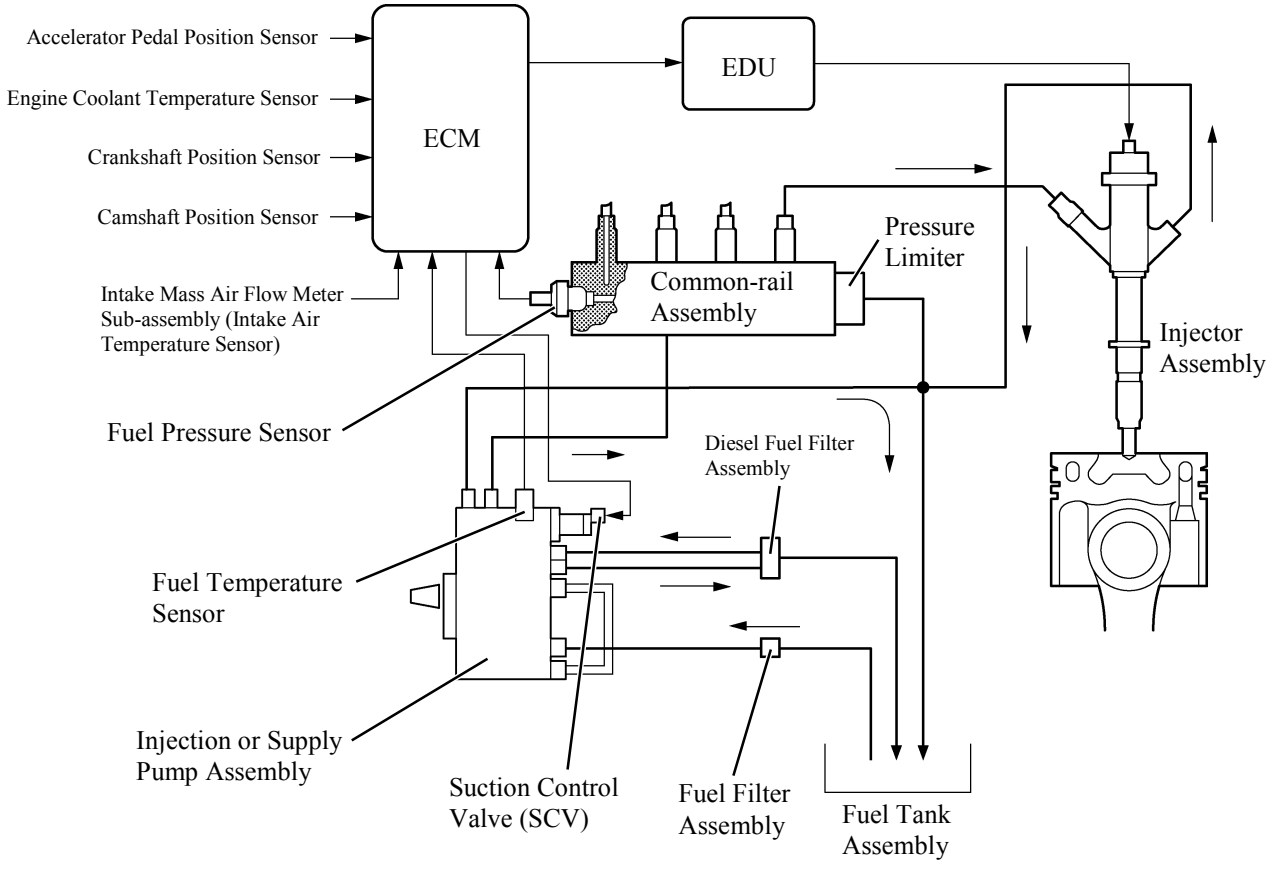
■ COMMON-RAIL SYSTEM

1. General

- In the common-rail system, the pressurized fuel provided by the injection or supply pump assembly is stored in the common-rail and injected by the solenoid injectors.
- The common-rail system stores the fuel, which has been pressurized by the pump, in the common-rail assembly. Because the common-rail assembly constantly accumulates a stable injection pressure without being affected by engine speed or load, this system is able to constantly provide a stable injection pressure, even when the engine is operating at low speeds.
- The ECM transmits signals to the injector solenoid valves via the EDU (Electronic Driver Unit) in order to precisely control the fuel injection timing and injection volume.

System Diagram



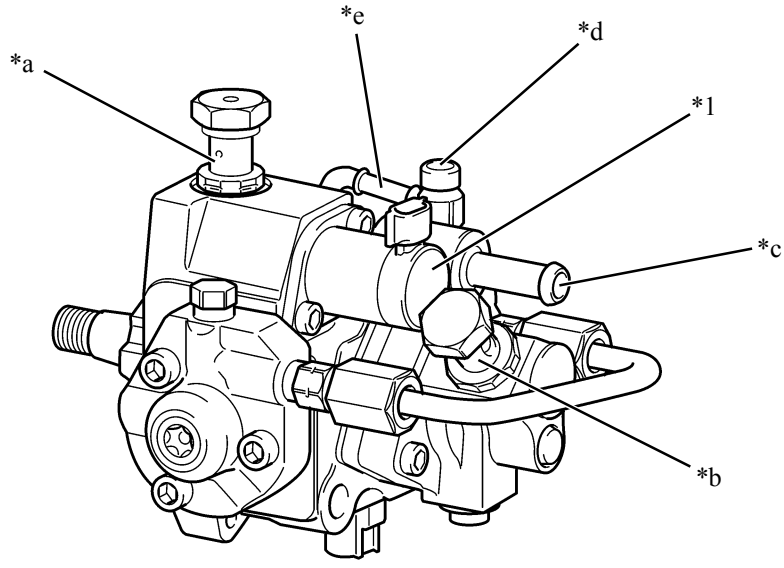
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2. Main Components of Common-rail System

1) Supply Pump

a. General

- An electronically controlled injection or supply pump assembly to implement super high pressure, low drive torque has been employed.
- The injection or supply pump assembly intakes the appropriate amount of fuel, and then sends high-pressure fuel to the common-rail assembly.
- The intake and pumping of fuel has been divided into 2 systems to stabilize the fuel supply.
- The 2 plungers to pump fuel have been arranged in opposition to make the entire pump more compact.



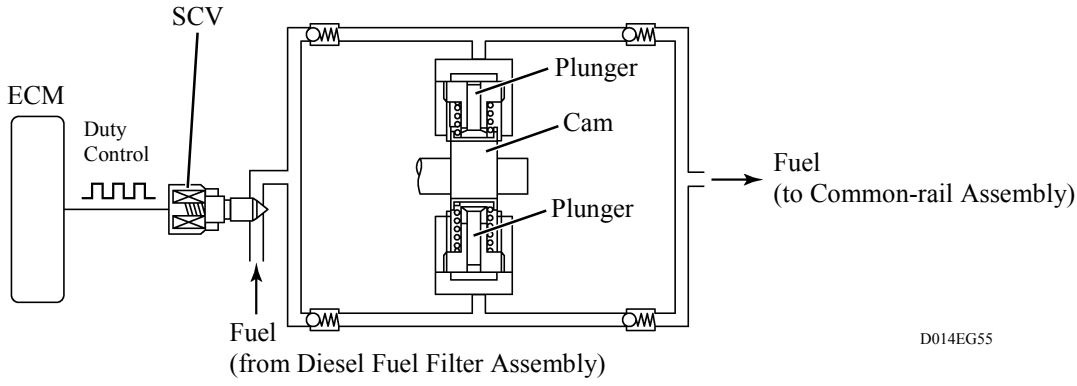
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Text in Illustration

*1	Suction Control Valve (SCV)	-	-
*a	from Diesel Fuel Filter Assembly	*b	to Diesel Fuel Filter Assembly
*c	from Fuel Filter Assembly	*d	to Common-rail Assembly
*e	to Fuel Tank Sub-assembly	-	-

b. SCV (Suction Control Valve)

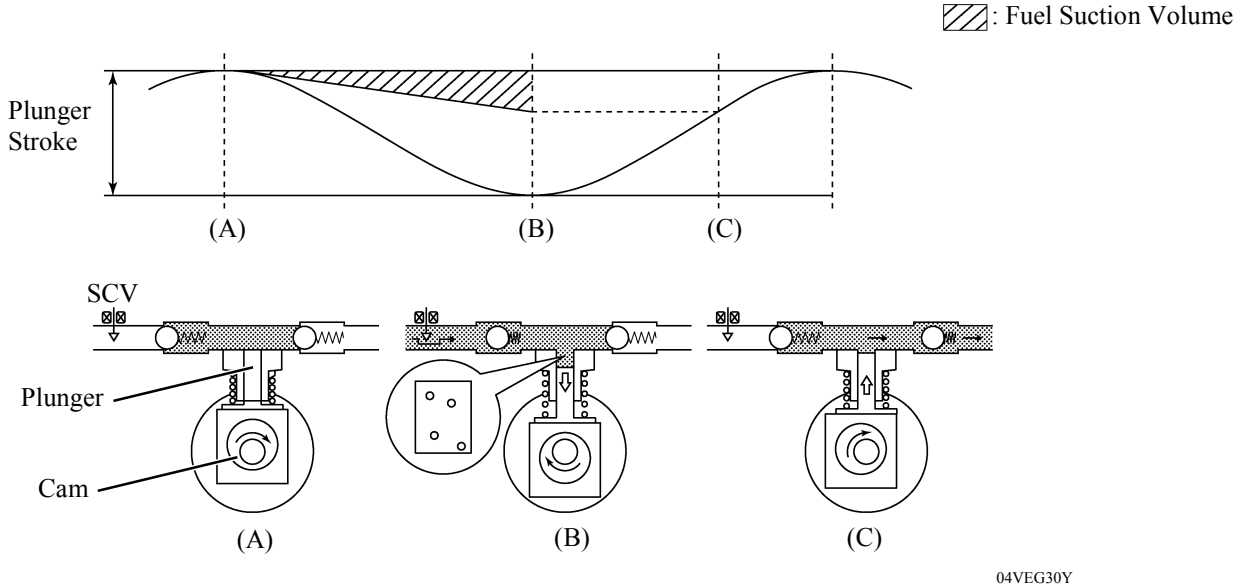
- The ECM determines the target fuel pressure based on the load condition.
- The ECM adjusts the SCV opening angle by the duty control function to reach the target fuel pressure.
- The suction control valve adjusts the fuel pressure in the range of 25 MPa to 160 MPa.



c. Operation

Small Opening of Suction Control Valve

- When the opening of the suction control valve is small, the fuel suction passage narrows and slows down the fuel flow.
- Even if the plunger reaches its maximum stroke, the volume of fuel drawn in by the plunger becomes restricted because the fuel suction passage is restricted. (See "B" in the diagram.)
- The injection or supply pump assembly discharges fuel when the cam pushes the plunger upward and the fuel discharge pressure becomes higher than the fuel pressure in the common-rail assembly. (See "C" in the diagram.)



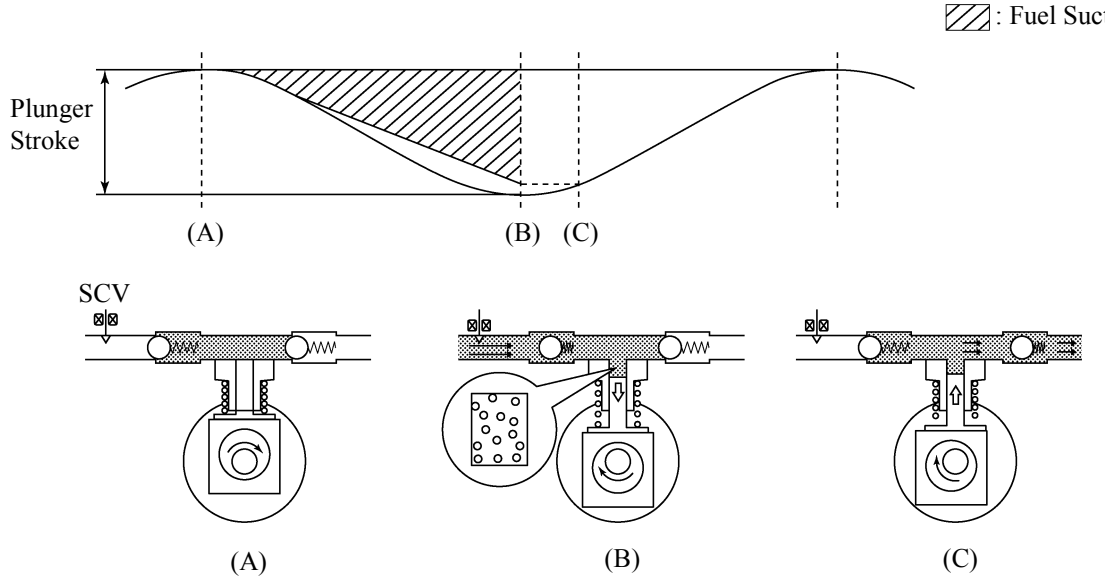
(A) Plunger Top-Dead-Center

(B) Plunger Bottom-Dead-Center

(C) Compression Starting Point

Large Opening of Suction Control Valve

- When the opening of the suction control valve is large, the fuel suction passage widens and facilitates the fuel flow.
- When the plunger reaches its maximum stroke, the plunger draws an ample volume of fuel because the fuel suction passage is not restricted. (See "B" in the diagram.)
- The injection or supply pump assembly discharges fuel when the cam pushes the plunger upward and the fuel discharge pressure becomes higher than the fuel pressure in the common-rail assembly. (See "C" in the diagram.)



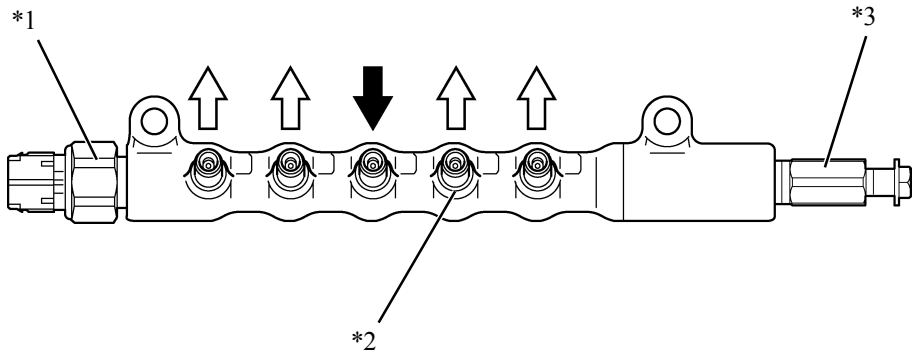
(A) Plunger Top-Dead-Center

(B) Plunger Bottom-Dead-Center

(C) Compression Starting Point

2) Common-rail

- A common-rail assembly made of chromium molybdenum steel was employed to guarantee the reliability against fuel pressure fluctuations.
- Accumulating high-pressure fuel in the rail section enabled electronically controlled injection by an injector assembly.
- The fuel pressure limiter assembly relieves pressure when the pressure inside the common-rail assembly has become extremely high.
- A fuel pressure sensor measures the fuel pressure and outputs it to the ECM to limit the fuel pressure inside the common-rail assembly. This guarantees optimal combustion and reduces combustion noise.



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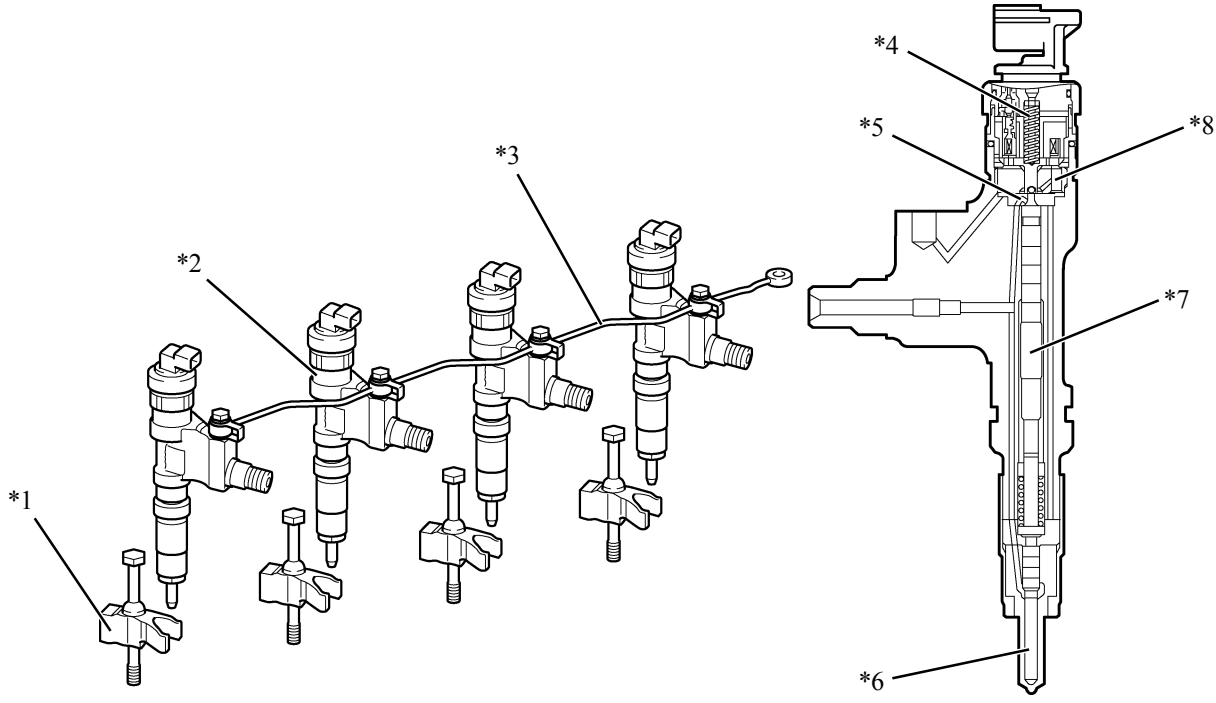
Text in Illustration

*1	Fuel Pressure Sensor	*2	Common-rail Assembly
*3	Fuel Pressure Limiter Assembly	-	-
 0479EG26	from Injector or Supply Pump Assembly	 0479EG28	to Injector Assembly

3) Injector

a. General

- Because this system uses solenoid injectors in which solenoid valves open and close the fuel passages, the ECM can precisely control the fuel injection volume and injection timing. Thus, this system minimizes the generation of black smoke, which is peculiar to diesel engines.
- Each injector assembly consists of a nozzle needle, piston, and solenoid valve.
- An injector assembly compensation value and QR (Quick Response) code containing encoded characteristics of the injector assembly are printed on each injector assembly
- The injector assembly compensation value and QR code contain various pieces of information regarding the injector assembly, such as model code and injection volume values.



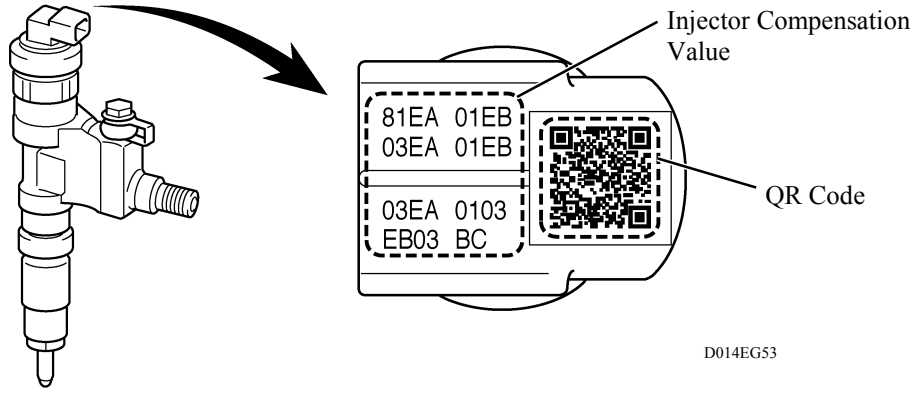
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Text in Illustration

*1	Holder	*2	Injector Assembly
*3	Nozzle Leakage Pipe Assembly	*4	Solenoid Valve
*5	Command Chamber	*6	Nozzle Needle
*7	Piston	*8	Valve Assembly

Service Tip

- If the ECM is replaced, use the Global TechStream (GTS) and input the injector compensation values of all 4 injectors. If an injector assembly is replaced, input the injector assembly compensation value of the replaced injector assembly. Then, the proper compensation will be made so that the injection volume precision prior to the replacement will remain unchanged. For details, refer to the Repair Manual.
- The QR code, which requires a special scan tool, is not used at TOYOTA dealers.



—REFERENCE—

What is QR (Quick Response) Code?

- *QR code, a matrix symbology consisting of an array of nominally square cells, allows omni-directional, high-speed reading of large amounts of data.*
- *QR code encodes many types of data such as numeric, alphanumeric, kanji, kana and binary code. A maximum of 7,089 characters (numeric) can be encoded.*
- *QR code (2D code) contains information in the vertical and horizontal directions, whereas a bar code contains data in one direction only. QR code (2D code) holds a considerably greater volume of information than a bar code.*

b. Operation

(a) When electrical current is applied to the solenoid coil, it pulls the solenoid valve up.
(b) The orifice of the command chamber opens, allowing the fuel to flow out.
(c) The fuel pressure in the command chamber drops.
(d) Simultaneously, fuel flows from the orifice to the bottom of the piston, which raises the piston.
(e) As a result, the piston raises the nozzle needle to inject fuel.

