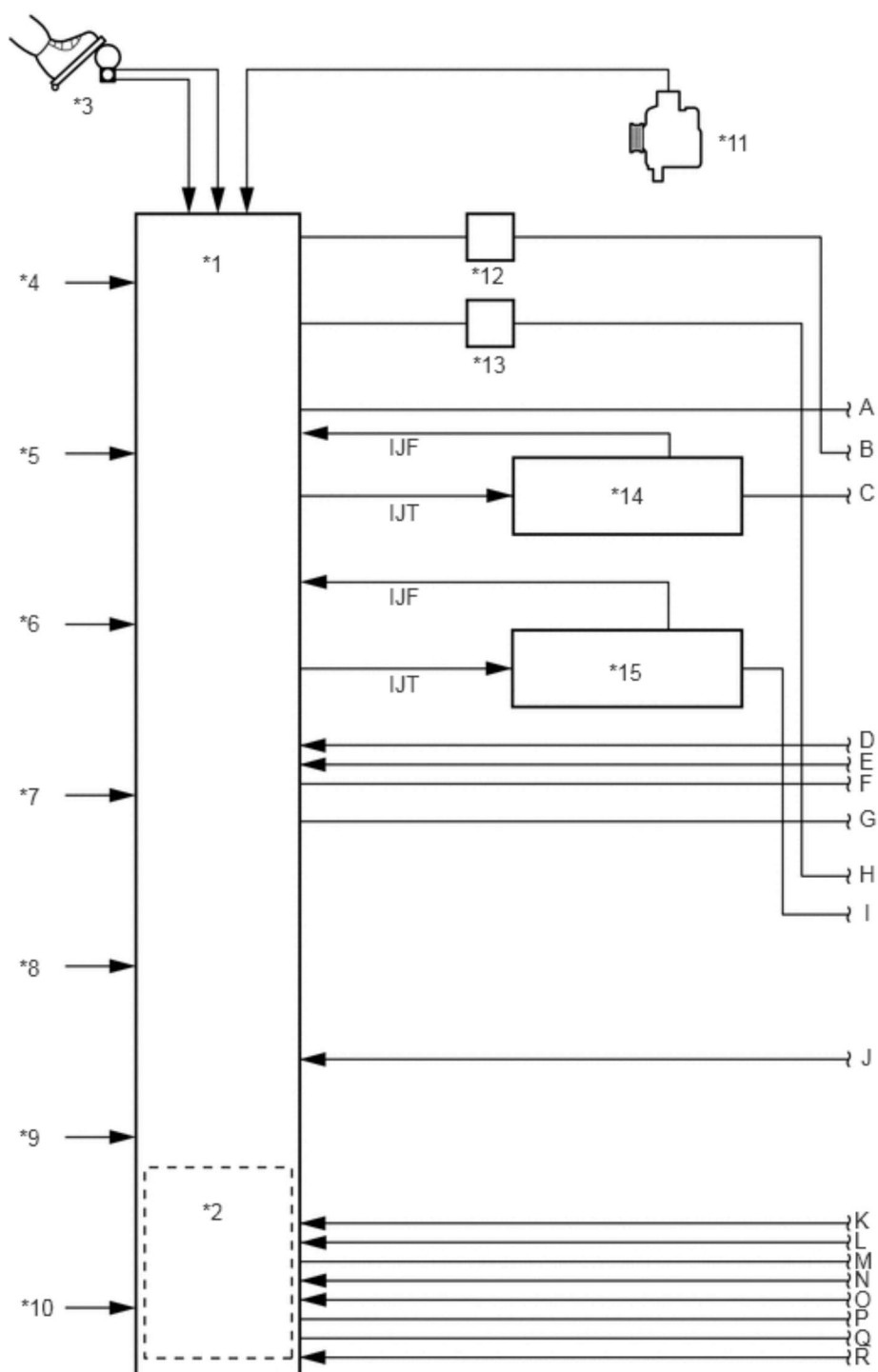
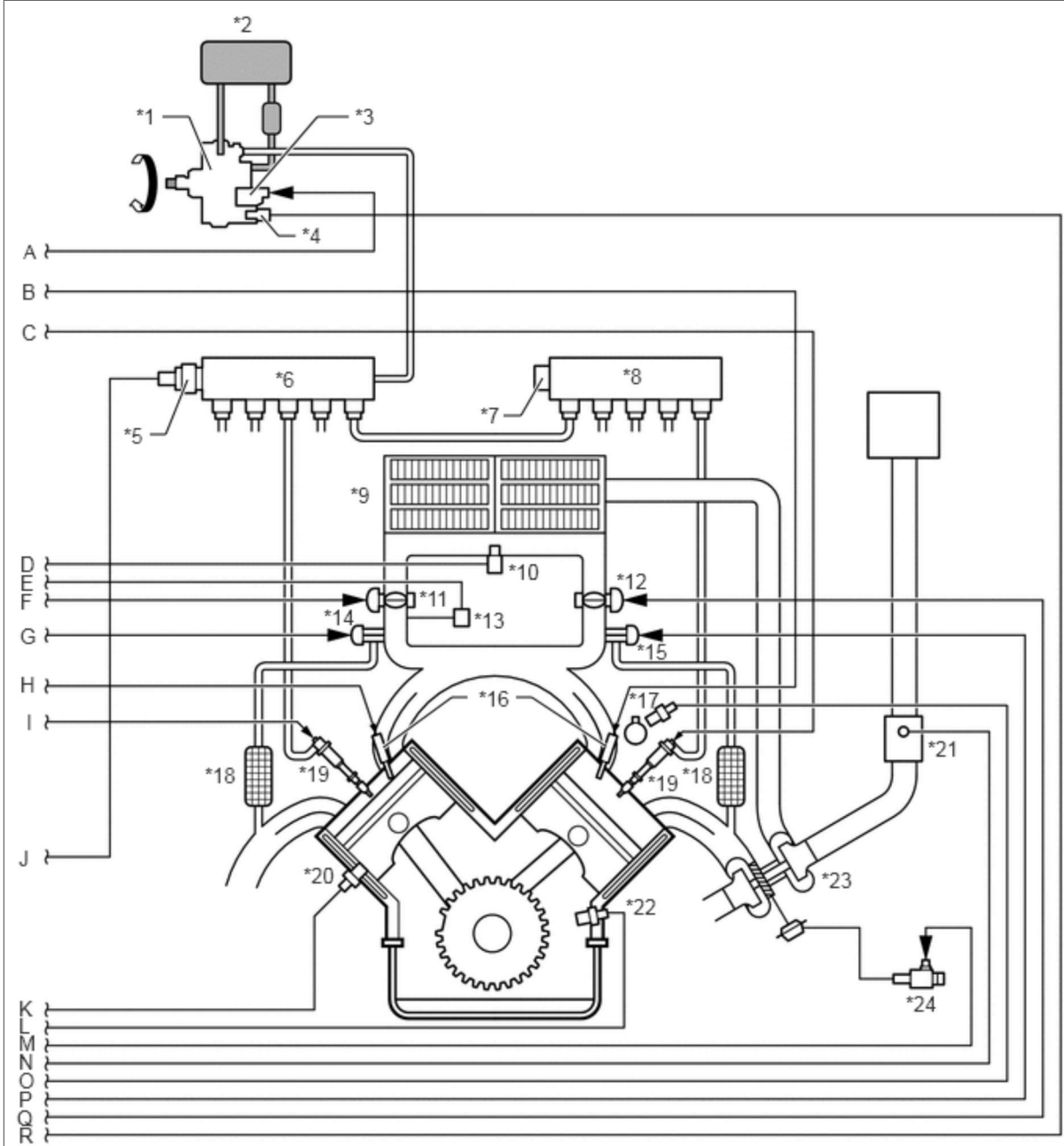


ENGINE CONTROL SYSTEM



P

*1	ECM	*2	Atmospheric Pressure Sensor
*3	Accelerator Pedal Position Sensor	*4	Ignition Switch Signal
*5	Starter Signal	*6	Vehicle Speed Signal
*7	Battery Voltage	*8	DLC3
*9	Other Signal	*10	Stop Light Switch
*11	Generator	*12	No. 2 Glow Relay
*13	No. 1 Glow Relay	*14	No. 2 Injector Driver
*15	No. 1 Injector Driver	-	-



*1	Fuel Supply Pump	*2	Fuel Tank
*3	Suction Control Valve	*4	Fuel Temperature Sensor
*5	Fuel Pressure Sensor	*6	Common Rail RH
*7	Pressure Limiter	*8	Common Rail LH
*9	Intercooler	*10	Intake Air Temperature Sensor
*11	Diesel Throttle Body (for Bank 1)	*12	Diesel Throttle Body (for Bank 2)
*13	Manifold Absolute Pressure Sensor	*14	No. 1 EGR Valve
*15	No. 2 EGR Valve	*16	Glow Plug
*17	Camshaft Position Sensor	*18	EGR Cooler
*19	Fuel Injector	*20	Engine Coolant Temperature Sensor
*21	Mass Air Flow Meter	*22	Crankshaft Position Sensor
*23	Turbocharger	*24	VRV

COMMON RAIL SYSTEM DESCRIPTION

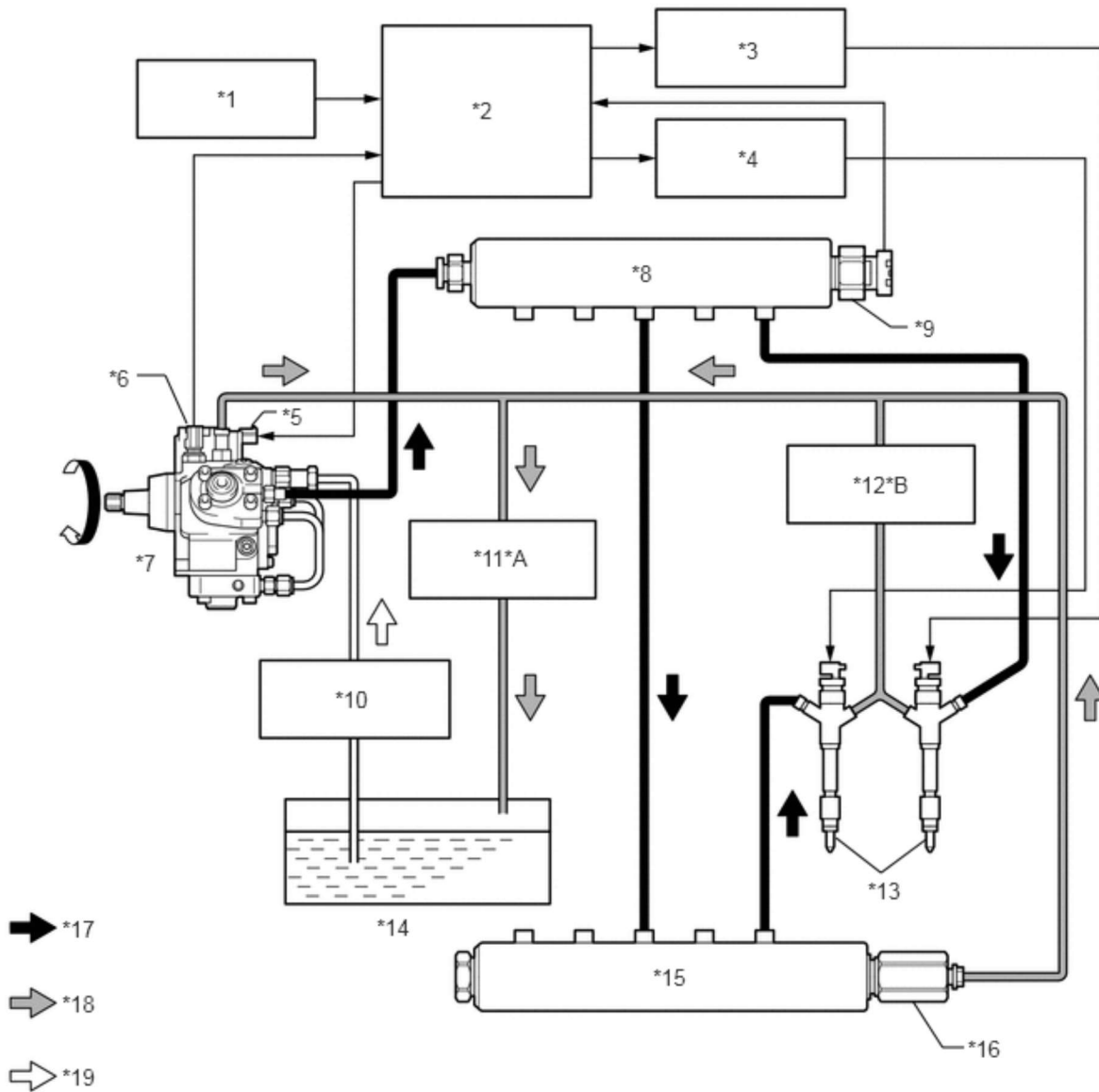
COMMON RAIL SYSTEM:

The common rail system uses high-pressure fuel to improve fuel economy and to provide robust engine power, while suppressing engine vibration and noise. This system stores fuel, which has been pressurized and supplied by the fuel supply pump, in the common rail. By storing fuel at high-pressure, the common rail system can provide fuel at stable fuel injection pressures, regardless of engine speed or engine load.

The ECM regulates the fuel injection timing and volume by using the EDU to provide an electric current to the solenoid valve in the injector. The ECM also monitors the internal fuel pressure of the common rail using the fuel pressure sensor. The ECM causes the fuel supply pump to supply the fuel necessary to obtain the target fuel pressure.

In addition, this system has a 2-Way Valve (TWV) inside the injector to open and close the fuel passage. As a result, both fuel injection timing and fuel injection volume can be precisely regulated by the ECM.

The common rail system provides two split fuel injections. In order to soften combustion shock, this system performs "pilot-injection" as the subsidiary fuel injection prior to the main fuel injection. This helps to reduce engine vibration and noise.



*1	Sensors	*2	ECM
*3	No. 1 EDU	*4	No. 2 EDU
*5	Suction Control Valve	*6	Fuel Temperature Sensor
*7	Fuel Supply Pump	*8	Common Rail RH
*9	Fuel Pressure Sensor	*10	Fuel Filter
*11	Fuel Cooler*1	*12	Fuel Cooler*2
*13	Fuel Injector	*14	Fuel Tank
*15	Common Rail LH	*16	Pressure Limiter
*17	High Pressure Fuel	*18	Return Fuel
*19	Suction Fuel	-	-
*A	Air-cooled Type	*B	Water-cooled Type

COMMON RAIL SYSTEM COMPONENTS:

Component	Description
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Component	Description
Common rail	Stores high-pressure fuel produced by fuel supply pump
Fuel supply pump	Operated by crankshaft. Supplies high-pressure fuel to common rail.
Fuel Injector	Injects fuel to combustion chamber based on signals from ECM
Fuel pressure sensor	Monitors internal fuel pressure of common rail and sends signals to ECM
Pressure limiter	Opens pressure limiter valve to reduce internal pressure in common rail when common rail pressure exceeds specified level
Suction control valve	Based on signals from ECM, adjusts fuel volume supplied to common rail and regulates internal fuel pressure

DIAGNOSTIC TROUBLE CODE (DTC) TABLE FOR COMMON RAIL SYSTEM:

HINT:

This table indicates typical DTCs for each malfunction occurrence.

Component	Trouble Area	DTC No.
Fuel Injector	Open or short in injector circuit	P062D, P062E, P1238, P0093*
	Stuck open	P0093, P1238
	Stuck closed	P1238
Fuel pressure sensor	Open or short in fuel pressure sensor circuit or pressure sensor output fixed	P0087, P0190, P0192, P0193
Pressure limiter	Stuck open	P0093
	Stuck closed	P0088*
Suction control valve	Open or short in suction control valve circuit	P0627, P1229, P0088*
	Stuck open	P1229, P0088*
	Stuck closed	-
Injector driver (EDU)	Faulty EDU	P0093*, P062D*, P062E*, P1238*
Common rail system (Fuel system)	Fuel leaks in high-pressure areas	P0093

HINT:

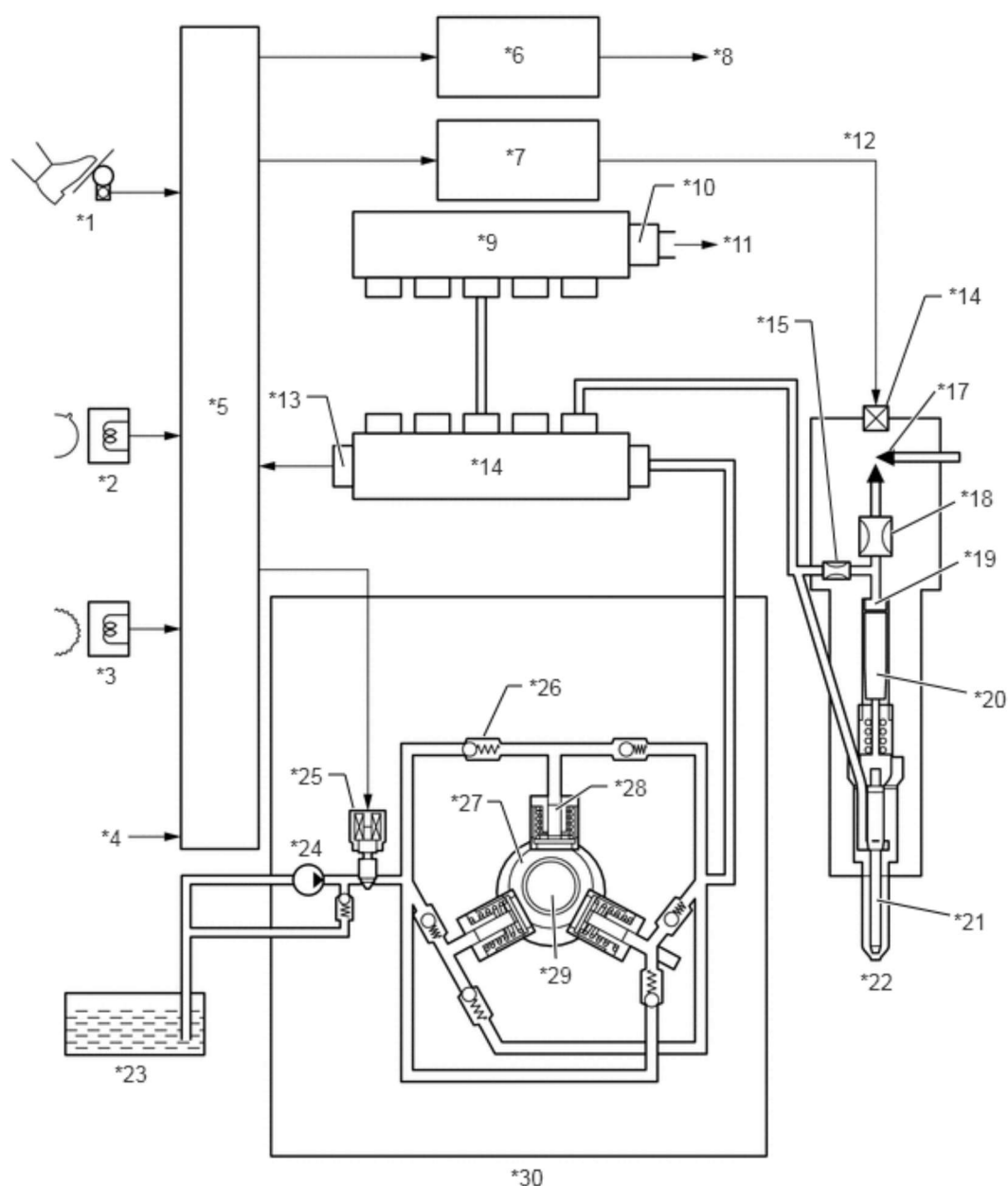
*: There may be no DTC output depending on the condition of the malfunction.

DIAGNOSTIC TROUBLE CODE DESCRIPTION FOR COMMON RAIL SYSTEM:

DTC No.	Description
P0087	Fuel pressure sensor output does not change
P0088	Internal fuel pressure too high (230 MPa [2345 kgf/cm ² , 33350 psi] or more)
P0093	Fuel leaks in high-pressure areas
P0190	Open or short in fuel pressure sensor circuit (Low or high output)
P0192	Open or short in fuel pressure sensor circuit (Low output)
P0193	Open or short in fuel pressure sensor circuit (High output)
P062D	Open or short in No. 1 injector driver or injector circuit
P062E	Open or short in No. 2 injector driver or injector circuit
P0627	Open or short in suction control valve circuit
P1229	Fuel over-feed
P1238	Injection malfunction; excludes open or short in injector circuit

INJECTION CONTROL SYSTEM DESCRIPTION

The ECM controls the fuel injection system by using the injectors and fuel supply pump. The ECM regulates the fuel injection volume and fuel injection timing by controlling the duration and timing of the electric current provided to the solenoid valve in the injector. The ECM regulates injection pressure by controlling the suction control valve located in the fuel supply pump. The feed pump is used to pump fuel from the fuel tank to the fuel supply pump.



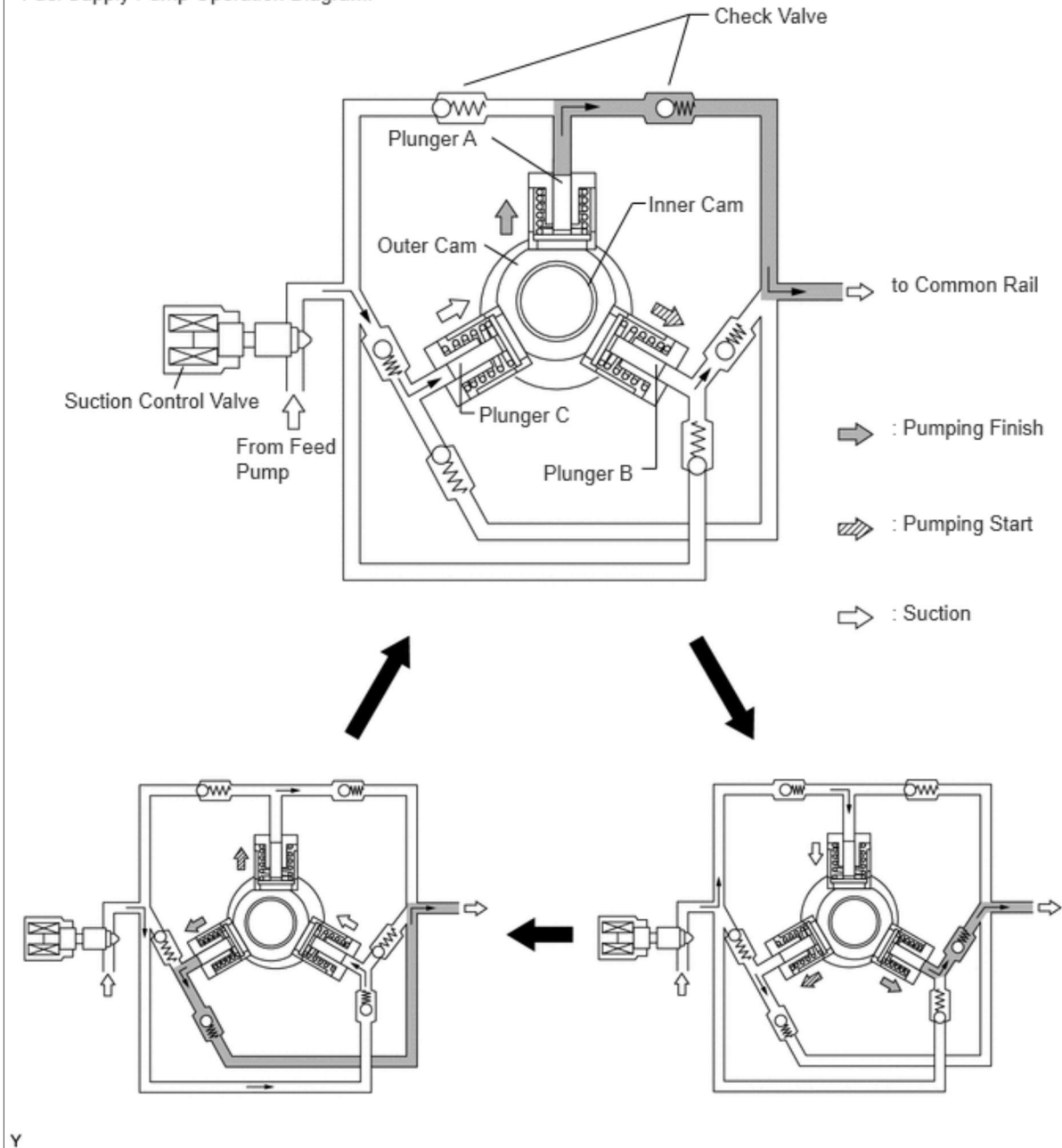
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*1	Accelerator Pedal Position Sensor	*2	Camshaft Position Sensor
*3	Crankshaft Position Sensor (NE signal)	*4	Other Sensors
*5	ECM	*6	No. 1 EDU
*7	No. 2 EDU	*8	Fuel Injector (#1, #4, #6, #7)
*9	Common Rail LH	*10	Pressure Limiter
*11	to Fuel Tank	*12	Fuel Injector (#2, #3, #5, #8)
*13	Fuel Pressure Sensor	*14	Common Rail RH
*15	Orifice	*16	Solenoid Valve
*17	TWV	*18	Orifice
*19	Control Chamber	*20	Piston
*21	Nozzle Needle	*22	Injector
*23	Fuel Tank	*24	Feed Pump
*25	Suction Control Valve	*26	Check Valve
*27	Outer Cam	*28	Plunger
*29	Inner Cam	-	Fuel Supply Pump

FUEL SUPPLY PUMP OPERATION SYSTEM DESCRIPTION

Due to the rotation of the inner cam (eccentric cam), the outer cam pushes plunger A upward as illustrated below. The force of the spring pulls plunger B and C. As a result, plunger B and C draw fuel in, and plunger A pumps fuel at the same time.

Fuel Supply Pump Operation Diagram:



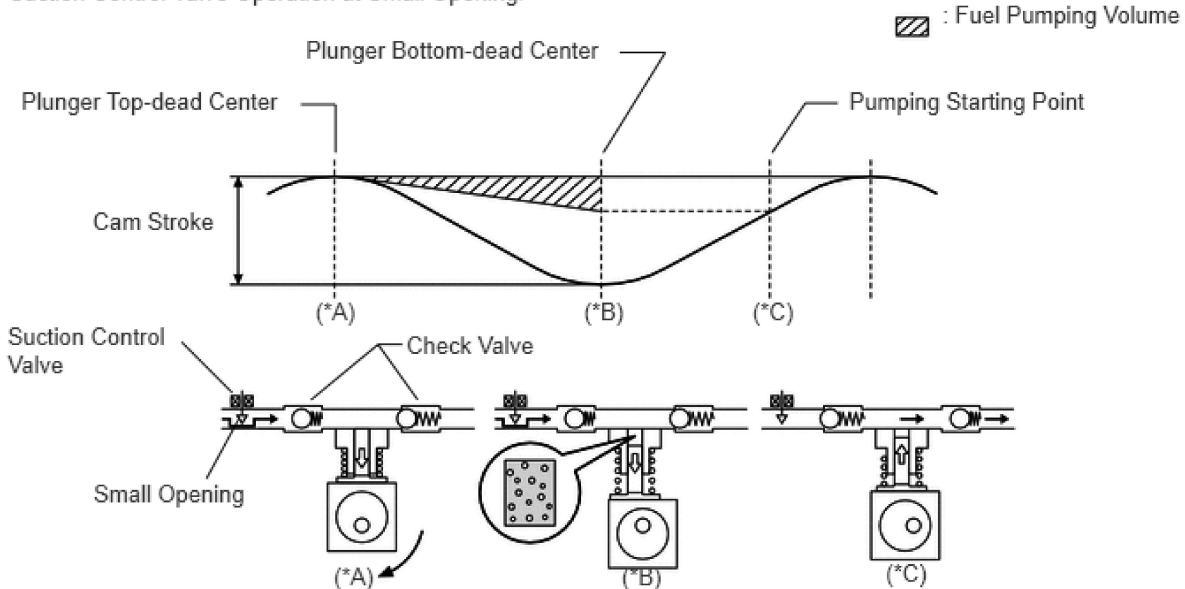
SUCTION CONTROL VALVE OPERATION SYSTEM DESCRIPTION

HINT:

The ECM controls the suction control valve operation to regulate the fuel volume that is pumped by the fuel supply pump to the common rail. This control is performed to adjust the internal fuel pressure of the common rail to the targeted injection pressure.

- a. Small opening of the suction control valve:
 - i. When the opening of the suction control valve is small, the fuel suction path is kept narrow. Therefore the transferable fuel volume is reduced (*A).
 - ii. The suction volume becomes small due to the narrow path despite the plunger stroke being full. The difference between the geometrical volume and suction volume creates a vacuum (*B).
 - iii. Pumping will start when the fuel pressure becomes higher than the common rail pressure (*C).

Suction Control Valve Operation at Small Opening:

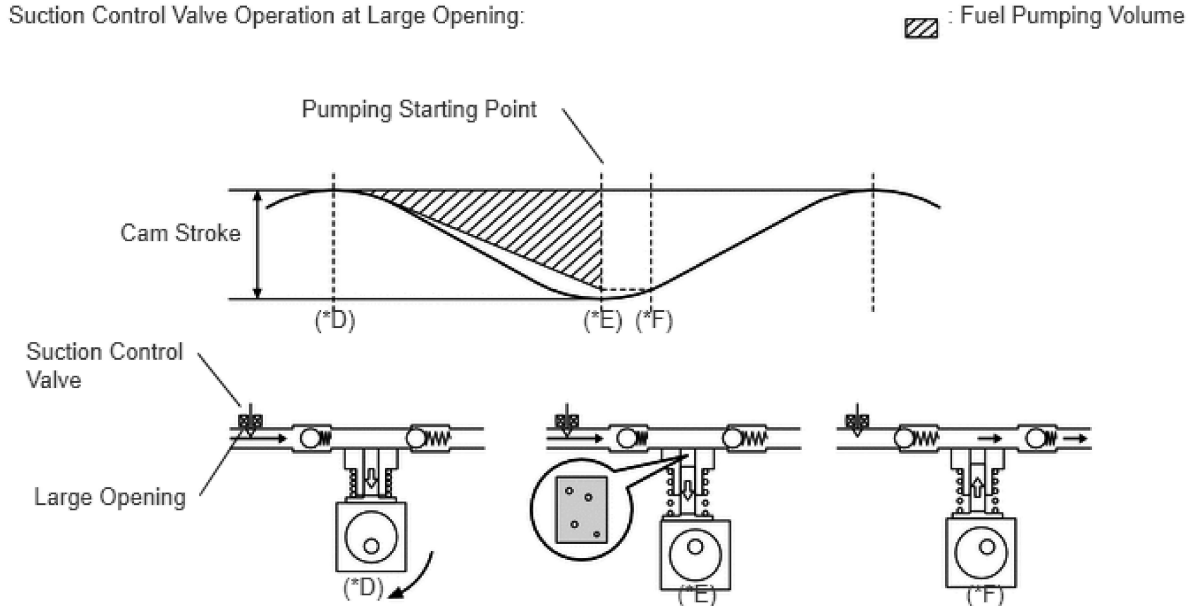


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b. Large opening of the suction control valve:

- i. When the opening of the suction control valve is large, the fuel suction path is kept wide. Therefore the transferable fuel volume is increased (*D).
- ii. If the plunger stroke is full, the suction volume becomes large because of the wide path (*E).
- iii. Pumping will start when the fuel pressure becomes higher than the common rail pressure (*F).

Suction Control Valve Operation at Large Opening:



Y