NEW FEATURES

ENGINE

■2TR-FE, 1KD-FTV, 2KD-FTV, 5L-E ENGINE

- A Brake Override System has been adopted for all engine models.

Engine Control System

Component	Function
Brake Override System	Restricts the driving torque when the brake pedal is applied while the accelerator pedal is depressed. (For the Activation Conditions and Inspection Method, refer to the repair manual)

■2TR-FE ENGINE

General

- Hong Kong package model conform to EURO V as a result of improved emissions purification performance achieved through changes to the two 3-way catalysts.
- Hong Kong package model has been added the intake manifold absolute pressure sensor.
- The air cleaner shape has been changed from a square type to a round type excluding Hong Kong package models.
- G.C.C. models conform to EURO III as a result of improved emissions purification performance achieved through changes to the two 3-way catalysts.

■1KD-FTV ENGINE (WITH DPF SYSTEM)

1. General

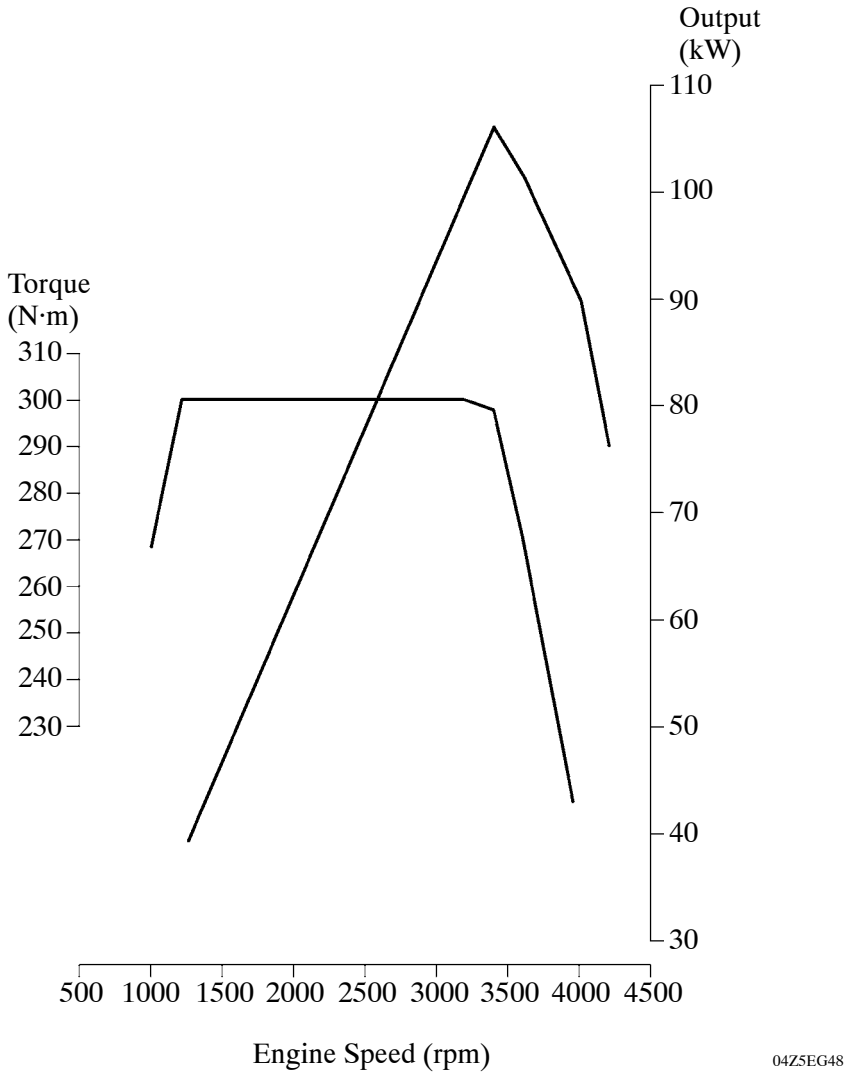
- A new specification 1KD-FTV engine that complies with the EURO V regulations has been adopted for the Hong Kong package models.
- The EURO V mode specification 1KD-FTV engine is an engine that is based on the conventional EURO IV C/D mode specification 1KD-FTV engine, but which has undergone a variety of modifications. This has led to a substantial improvement in power output, and allows it to conform to the EURO V mode regulations without using complex and expensive systems such as DPF, as well as realizing higher performance and cleaner emissions.
- For details of the changes from the conventional EURO V specification 1KD-FTV engine, see the Major Differences section (see page 15).

▶ Engine Specifications ◀

Model			New Model	Previous Model
Engine Type			1KD-FTV	1KD-FTV
No. of Cyls. & Arrangement			4-cylinder, In-line	←
Valve Mechanism			16-valves, DOHC, Belt & Gear Drive	←
Combustion Chamber			Direct Injection Type	←
Manifolds			Cross-flow	←
Fuel System			Common-rail Type	←
Displacement cm^3 (cu. in.)			2982 (182.0)	←
Bore × Stroke mm (in.)			96 × 103 (3.78 × 4.06)	←
Compression Ratio			15.0 : 1	16.0 : 1
Max. Output (EEC)			106 kW @ 3400 rpm	100 kW @ 3400 rpm
Max. Torque (EEC)			300 N·m @ 1200 – 3200 rpm	300 N·m @ 1200 – 2400 rpm
Valve Timing	Intake	Open	3° BTDC	2° BTDC
		Close	28° ABDC	37° ABDC
	Exhaust	Open	48° BBDC	45° BBDC
		Close	0° ATDC	←
Firing Order			1 – 3 – 4 – 2	←
Fuel Cetane Number			48 or higher	←
Emission Regulations			EURO V	EURO IV (C/D mode)
Oil Grade (Excluding Australia, New Zealand Models)			API: ACEA C2 SAE: 0W-30	←
Engine Service Mass* (Reference) kg (lb)			263 (580)	←

*: Weight shows the figure with the oil fully filled.

▶ Performance Curve ◀



2. Major Differences

The major differences between the newly adopted EURO V mode specification engine and the conventional EURO IV C/D specification engine are as shown in the table below.

System	Outline
Engine Specifications	In accordance with various changes, the following specifications have been changed. ● Max. output and Max. torque ● Lower compression ratio (16 : 1 → 15 : 1) ● The engine conforms to EURO V with regards to emission regulations.
Engine Proper	● The shape of the piston combustion chamber has been changed.
Lubrication System	● An Oil pump with variable discharge pressure has been adopted.
Cooling System	● The coolant passage has been partially changed.
Intake and Exhaust System	● The intake manifold has been changed. ● The swirl control valve has been changed. ● The EGR valve has been changed. ● The EGR cooler has been changed. ● The catalytic converter specifications have been optimized.
Fuel System	● The supply pump has been changed. ● The common-rail has been changed. ● The fuel injectors have been changed.
Engine Control System	● Exhaust gas temperature sensors have been added. ● The exhaust gas pressure sensor has been changed. ● An exhaust fuel addition injector has been adopted. ● Parts of the DPF (Diesel Particulate Filter) system have been added. ● A glow control unit has been adopted. ● An oil pump control system has been changed.

3. Features of 1KD-FTV engine

The 1KD-FTV engine achieves achieve the following through the adoption of the items listed in the table below.

(1) High performance and fuel economy

(2) Low noise and vibration

(3) Lightweight and compact design

(4) Good serviceability

(5) Clean emissions

Item		(1)	(2)	(3)	(4)	(5)	New Model	Previous Model
							1KD-FTV	1KD-FTV
Engine Proper	The cylinder head cover is made of plastic and the cylinder head is made of aluminum alloy.	—	—	○	—	—	○	○
	2 balance shafts are built into the cylinder block.	—	○	—	—	—	○	○
	An injector is provided in the bore center to improve the air utilization rate.	○	—	—	—	○	○	○
	The passage for the EGR is provided in the cylinder head.	—	—	—	—	○	○	○
	A piston provided with a combustion chamber is used in conjunction with the adoption of direct injection.	○	—	—	—	○	○	○
	A high swirl ratio is ensured by optimizing the shape of the combustion chambers of the cylinder head and pistons.	○	—	—	—	○	○	○
	The crankshaft pulley uses a torsional damper.	—	○	—	—	—	○	○
	A stiffening plate is provided between the cylinder block and the oil pan.	—	○	—	—	—	—	○
Valve Mechanism	The camshaft is driven by a timing belt and gear.	—	○	○	—	—	○	○
	An automatic tensioner is provided for the timing belt.	—	—	—	○	—	○	○
Cooling System	TOYOTA Genuine SLLC (Super Long Life Coolant) is used.	—	—	—	○	—	○	○
	The cooling fan is driven by a brushless DC motor.	○	○	—	—	—	○	○
Intake and Exhaust System	A swirl control valve is used.	○	○	—	—	○	○	○
	A catalytic converter (oxidation catalyst + DPF catalyst) is used in the front exhaust pipe.	—	—	—	—	○	○	—

(Continued)

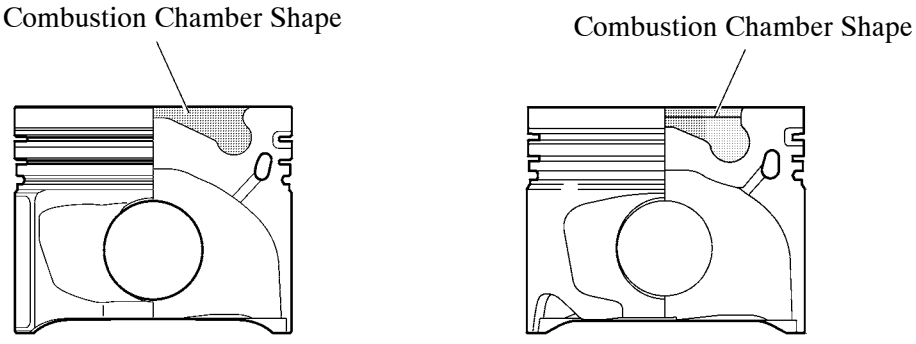
Item		(1)	(2)	(3)	(4)	(5)	New Model	Previous Model
							1KD-FTV	1KD-FTV
Intake and Exhaust System	A rotary solenoid motor type throttle control motor is used in the throttle body.	○	○	—	—	○	○	○
	A variable nozzle vane type turbocharger and high efficiency intercooler are used.	○	—	○	—	○	○	○
	EGR is used.	—	—	—	—	○	○	○
	An EGR valve position sensor is used.	—	—	—	—	○	○	○
	A water-cooled type EGR cooler is used.	—	—	—	—	○	○	○
	A large EGR cooler with a bypass switching valve is used.	—	—	—	—	○	○	○
Fuel System	An HP3 type supply pump is used.	○	○	○	—	—	○	○
	A common-rail type fuel injection system is used.	○	○	—	—	○	○	○
	A piezo actuator control type injector is used.	○	—	—	—	○	○	—
	A fuel cooler is used.	○	—	—	—	○	○	○
Charging System	A segment conductor type alternator is used.	—	—	○	—	—	○	○
Serpentine Belt Drive System	A serpentine belt drive system is used.	—	—	—	○	—	○	○
Engine Control System	A non-contact type throttle position sensor is used.	○	—	—	—	—	○	○
	A non-contact type accelerator pedal position sensor is used.	○	—	—	—	—	○	○
	A pilot injection control system is used.	○	○	—	—	○	○	○
	Small injection volume correction control and extensive intra-cylinder injection volume correction control have been added to the fuel injection volume control.	○	○	—	—	○	○	○
	DPF control system is used.	—	—	—	—	○	○	—

NF

4. Engine Proper

Piston

- With the change in the combustion chamber compression ratio (16.0 → 15.0), the combustion chamber shape is optimized and combustion efficiency is increased, increasing output, improving fuel economy, and reducing emissions.

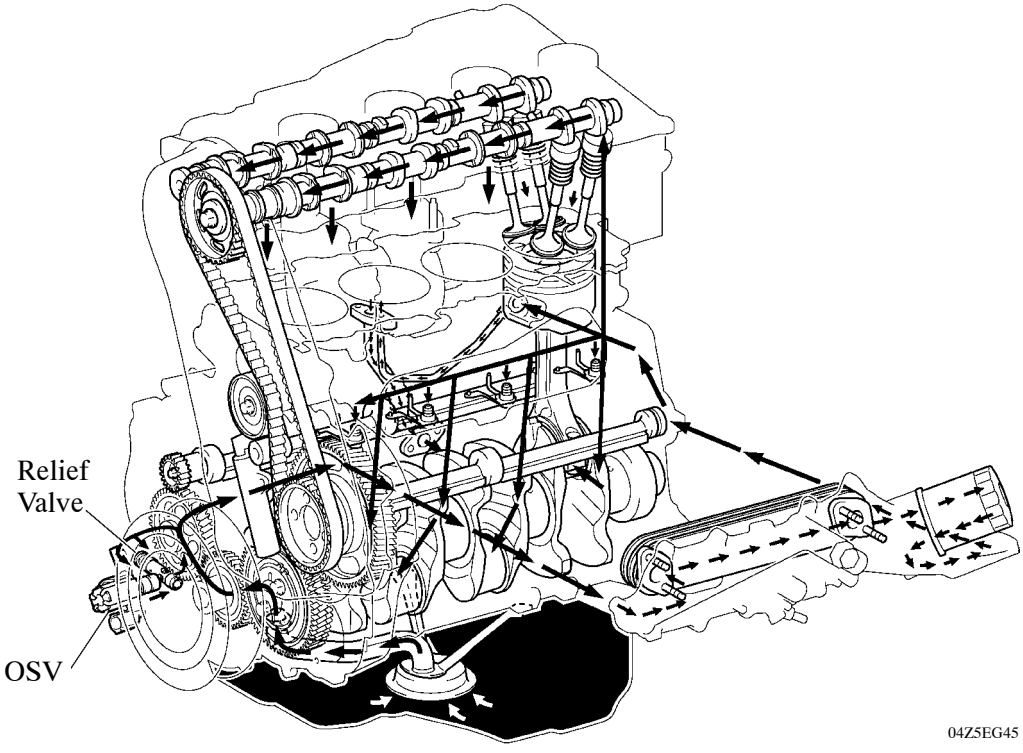


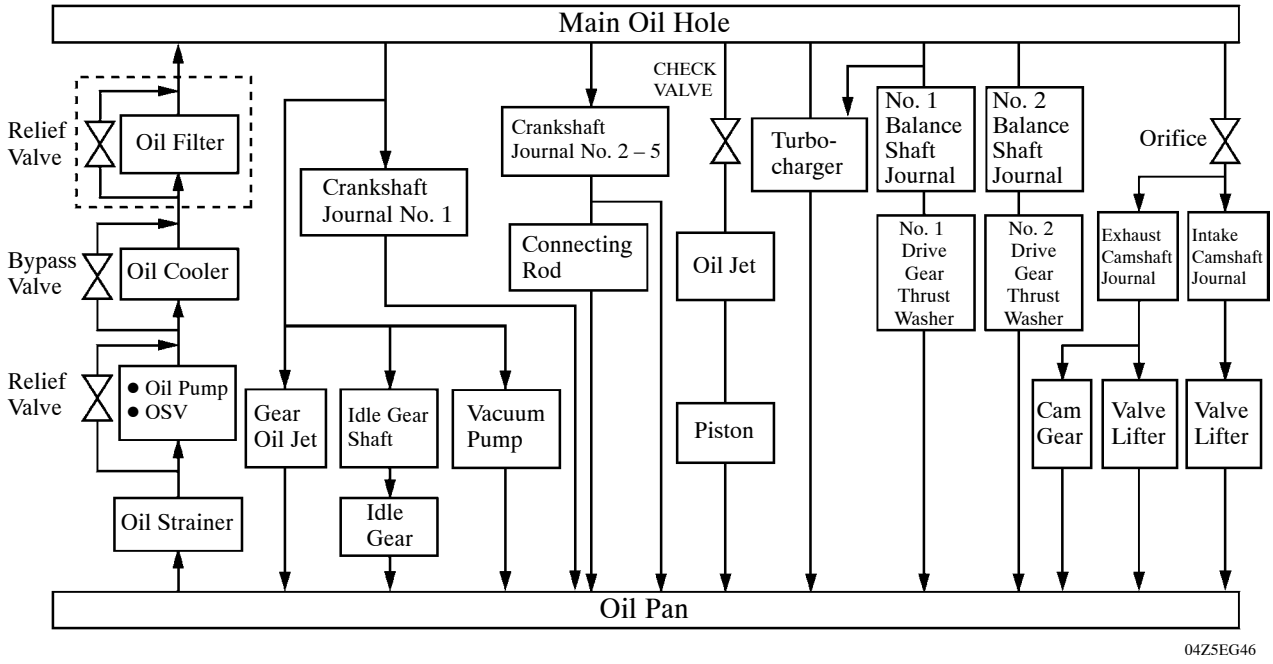
Piston Cross Section 04Z5EG40

5. Lubrication System

General

- An oil pump with variable discharge pressure that allows the engine oil pressure to be controlled in 2 stages according to the vehicle driving conditions has been adopted. Therefore, energy loss due to the driving of the oil pump has been reduced and fuel economy has been improved.





Oil Pump

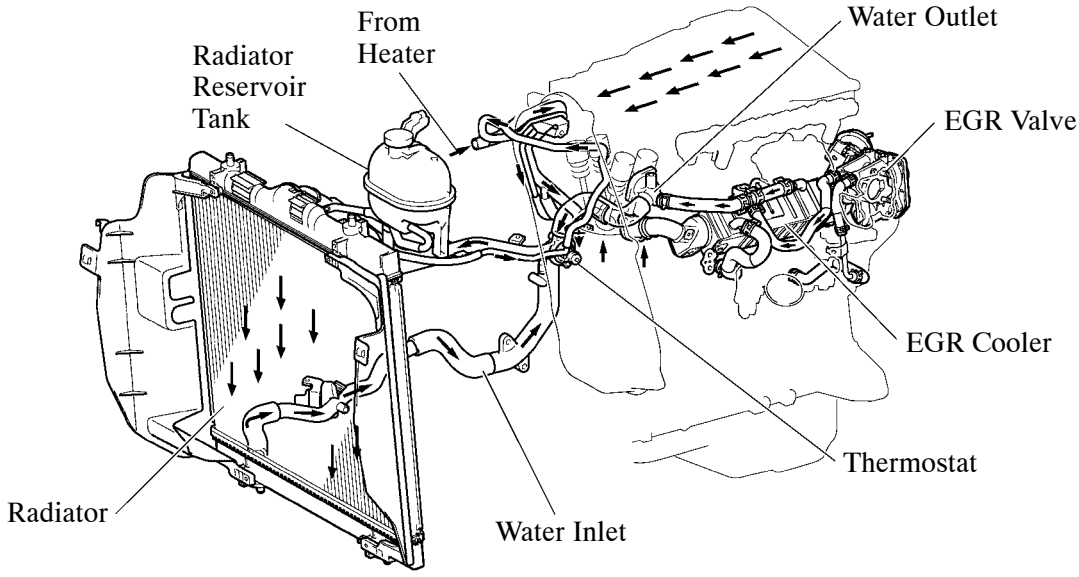
- An oil pump with variable discharge pressure that allows the engine oil pressure to be controlled in 2 stages according to the vehicle driving conditions has been adopted. Therefore, energy loss due to the driving of the oil pump has been reduced and fuel economy has been improved.

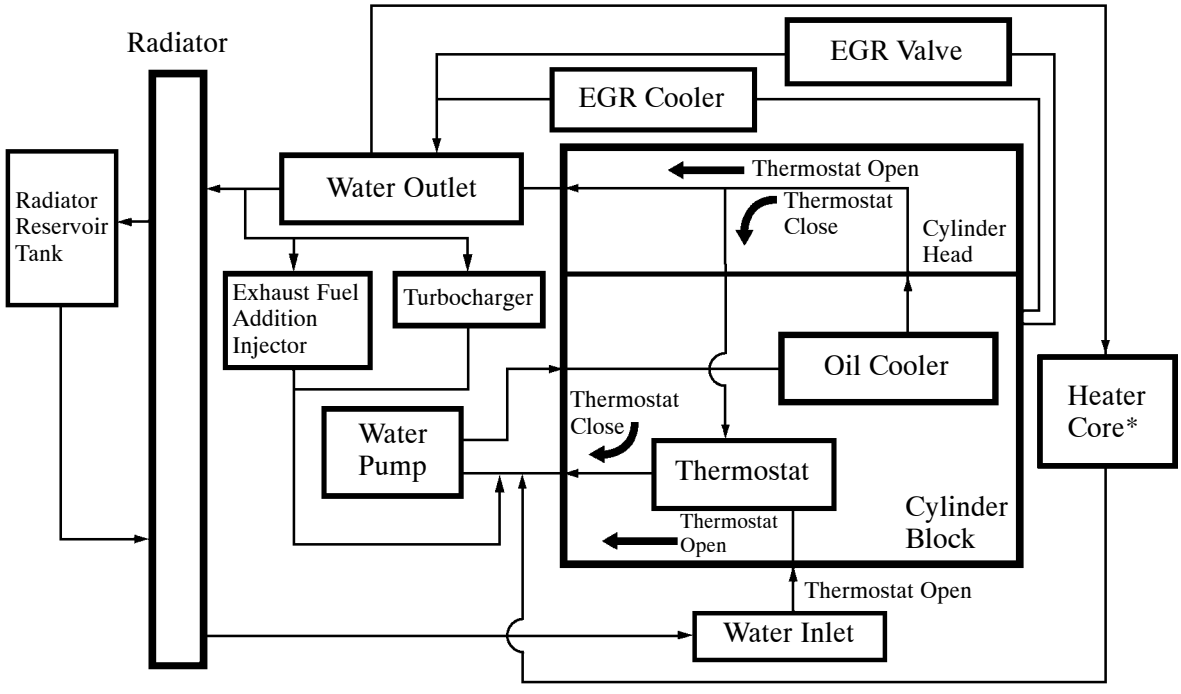
NF

6. Cooling System

General

- As a result of adopting an EGR cooler and EGR valve with new shapes, and adding the exhaust fuel addition injector, a minor change has been made to the cooling channel.



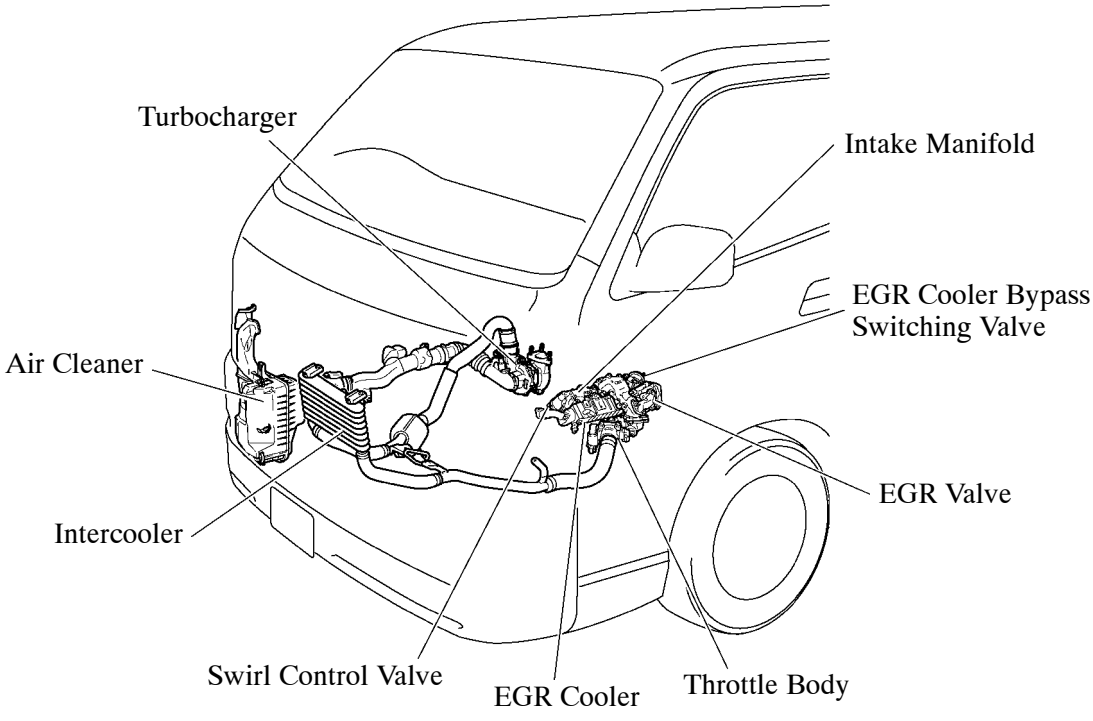


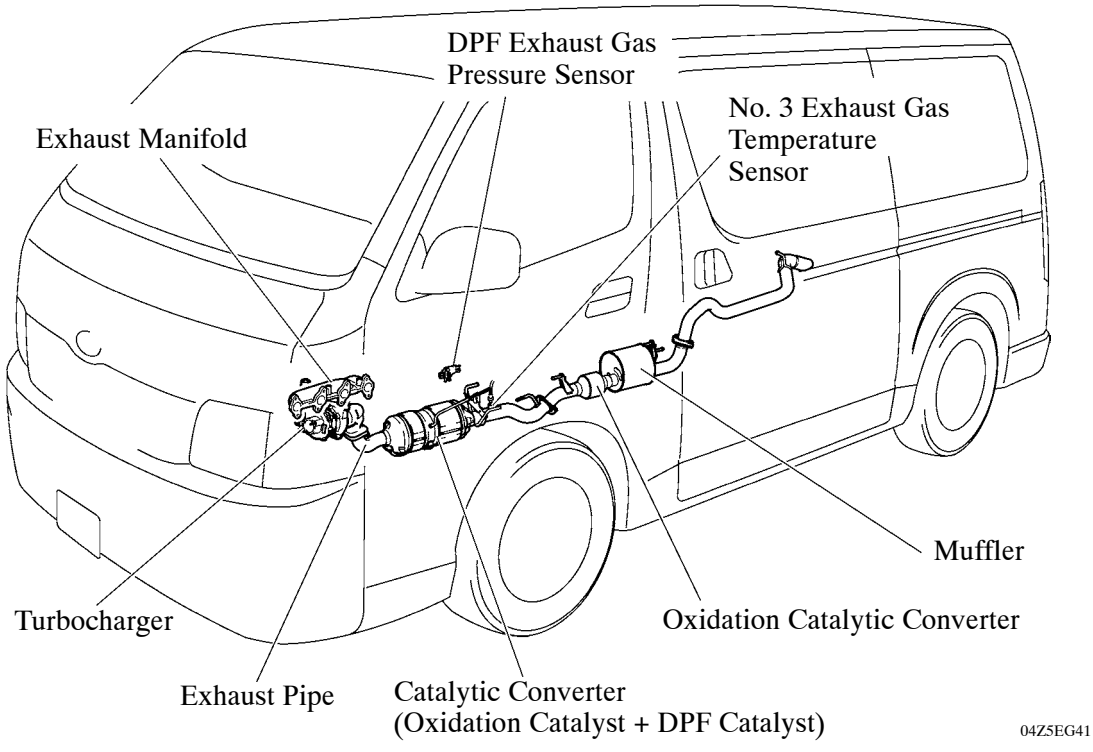
*: Models with Heater

7. Intake and Exhaust System

General

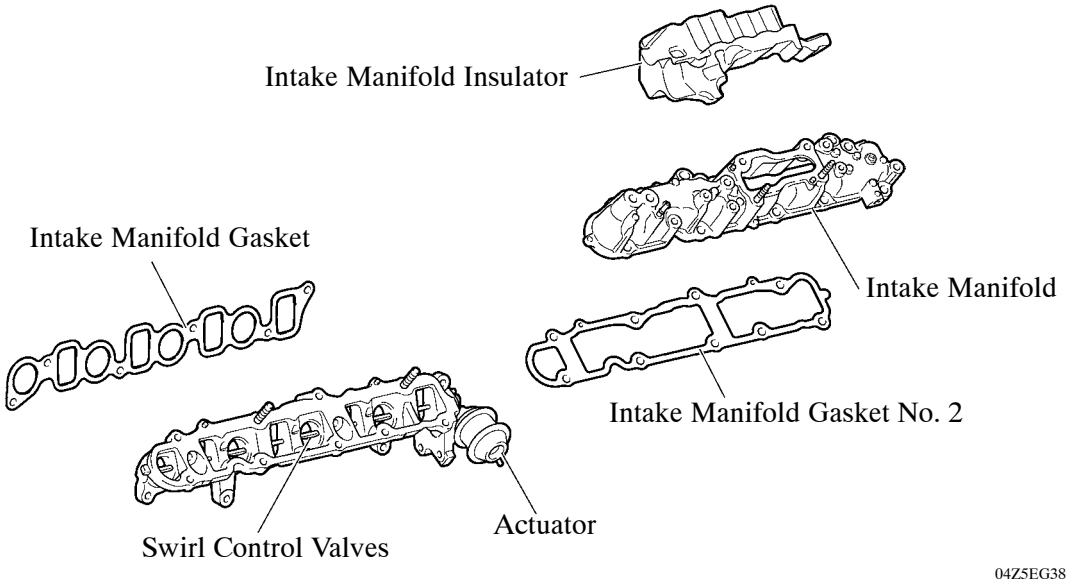
- The use of a compact electronically controlled variable nozzle-type turbocharger, large-capacity EGR cooler, DC motor-type EGR valve, and 3-stage swirl control valve yields higher fuel economy and lower emissions.





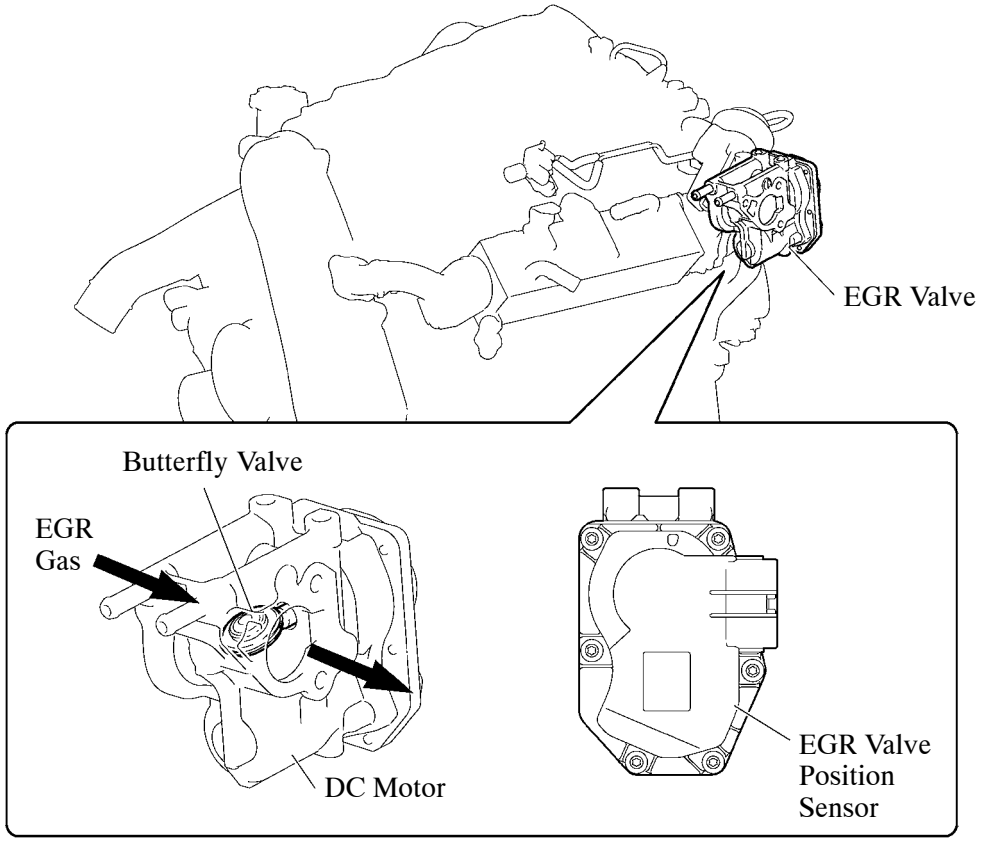
Intake Manifold

- The intake manifold has been changed from the previous type with an integrated swirl control valve to a type with a separate swirl control valve in order to equalize EGR gas amounts between cylinders as much as possible.
- A new insulator has been added between the intake manifold and common-rail. This reduces the noise caused by the standing wave generated by common-rail pulsations.



EGR Valve

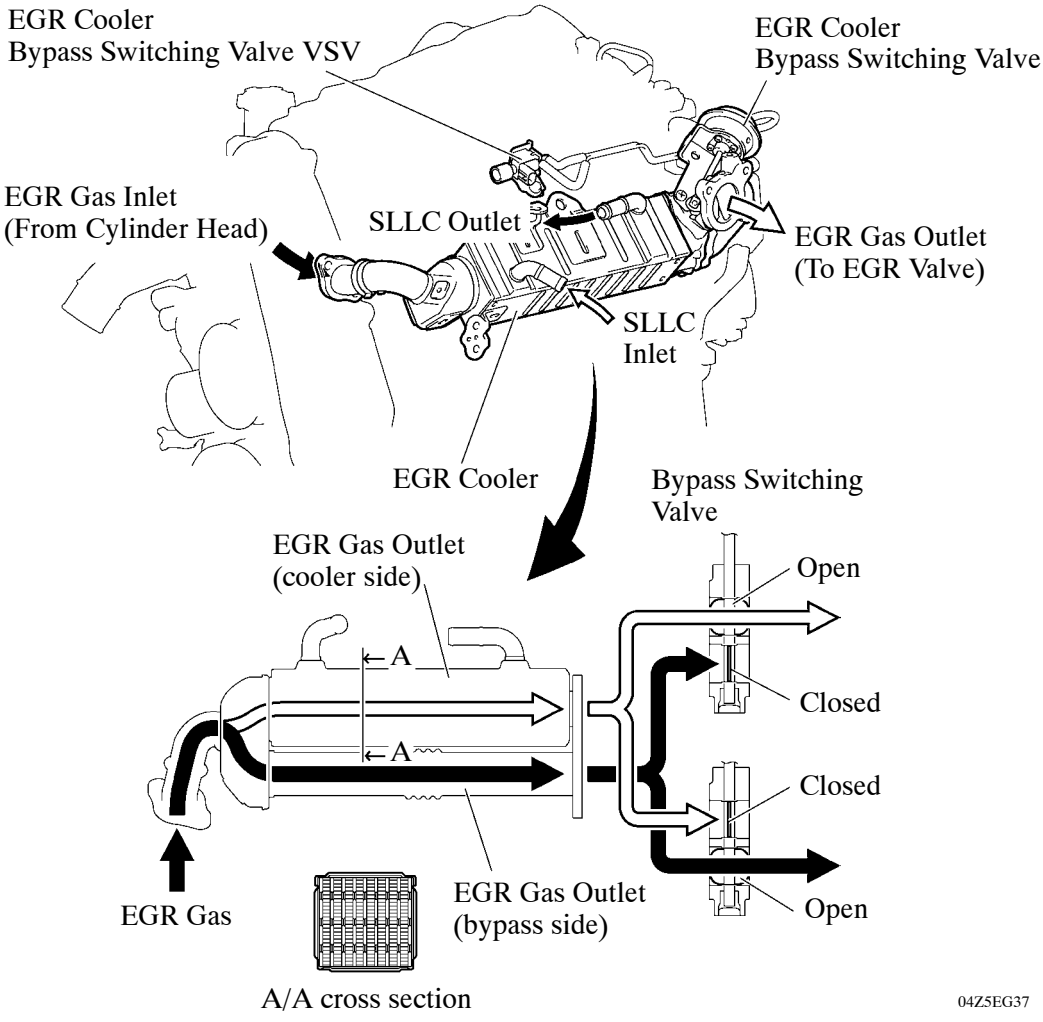
- The EGR gas inlet valve on the EGR valve has been changed from the previous outward-opening valve (vacuum type) to a butterfly valve (DC motor type). This provides a maximum EGR gas flow that is approximately twice the previous value, allowing a high EGR rate which complies with EURO V Emission Regulations.
- The use of a butterfly valve improves EGR flow control performance at small opening positions, allowing more precise control.
- A Hall IC-type EGR valve position sensor has been adopted. Monitoring the EGR valve position stabilizes valve behavior and achieves accurate EGR control.
- For details of EGR control, see page 43.



04Z5EG36

EGR Cooler

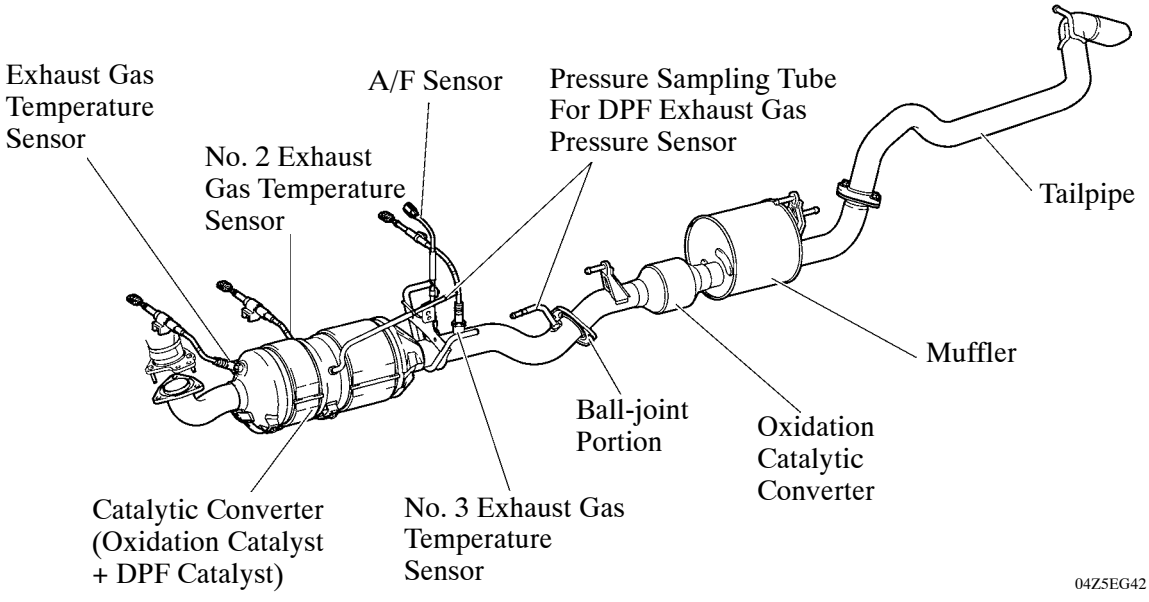
- The cooler channel of the EGR cooler has been changed from the previous U-shaped type to a straight type. This simplifies the shape and reduces the pressure loss. The core size has also been increased to improve the cooling efficiency, and the bypass channel has been made separate in order to ensure bypass efficiency.
- A bypass valve is installed on the EGR cooler exit, allowing the EGR gas to be switched between the cooling sides and bypass side according to the conditions of engine use.
- The EGR cooler bypass valve switches between the cooler channel and bypass channel by means of the EGR cooler bypass valve VSV. A pair of integrated valves displaced from each other by 90° is used, so that one opens when the other is closed, and the first closes when the other is open.



Exhaust Pipe

- The catalytic converter specifications have been optimized.
- Exhaust gas temperature sensors have been added to the front pipe.
- Due to the adoption of a differential-pressure type DPF exhaust gas pressure sensor, a pressure sampling tube has been added downstream of the A/F sensor.
- An oxidation catalyst has been added to the center pipe.
- The muffler has been made more compact and lightweight by reducing the muffler volume (18.4 L → 7.5 L) while ensuring sufficient capacity.

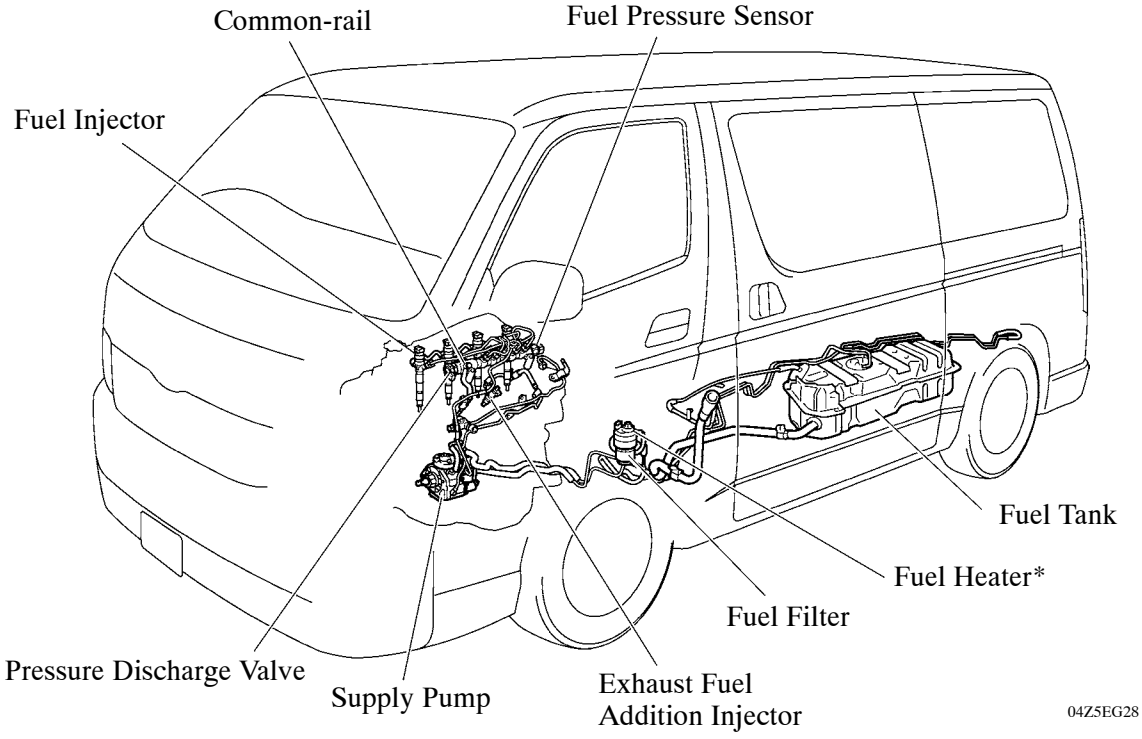
Model	New Model	Previous Model
Catalytic Converter Size	0.16 L + 2.0 L + 3.0 L + 1.3 L	0.5 L + 1.3 L



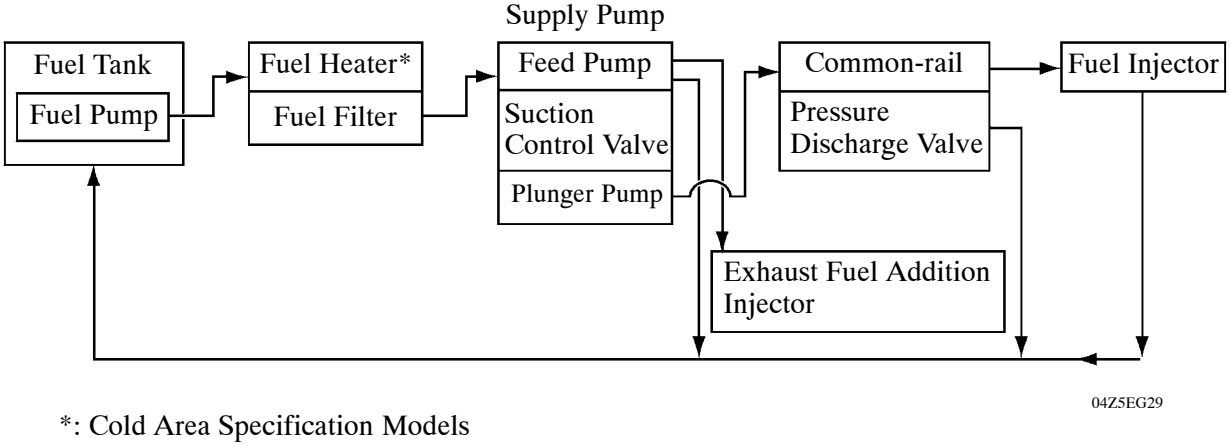
8. Fuel System

General

- The maximum common-rail fuel pressure has been increased from 180 MPa to 200 MPa. In combination with piezo type fuel injectors, this improves fuel injection accuracy and achieves greater fuel atomization. This results in higher output and lower emissions, as well as improved fuel economy.



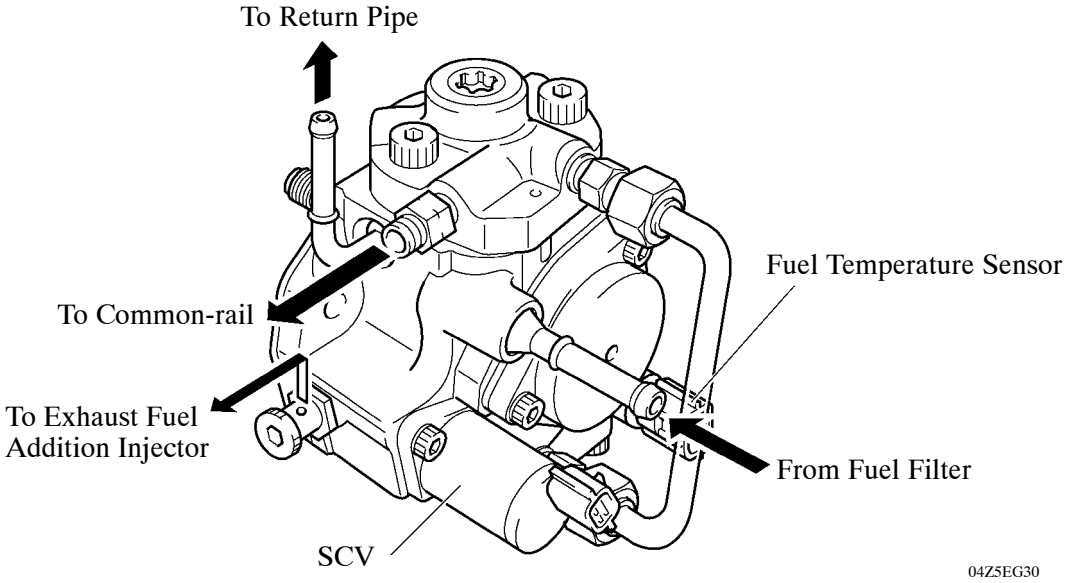
*: Cold Area Specification Models



*: Cold Area Specification Models

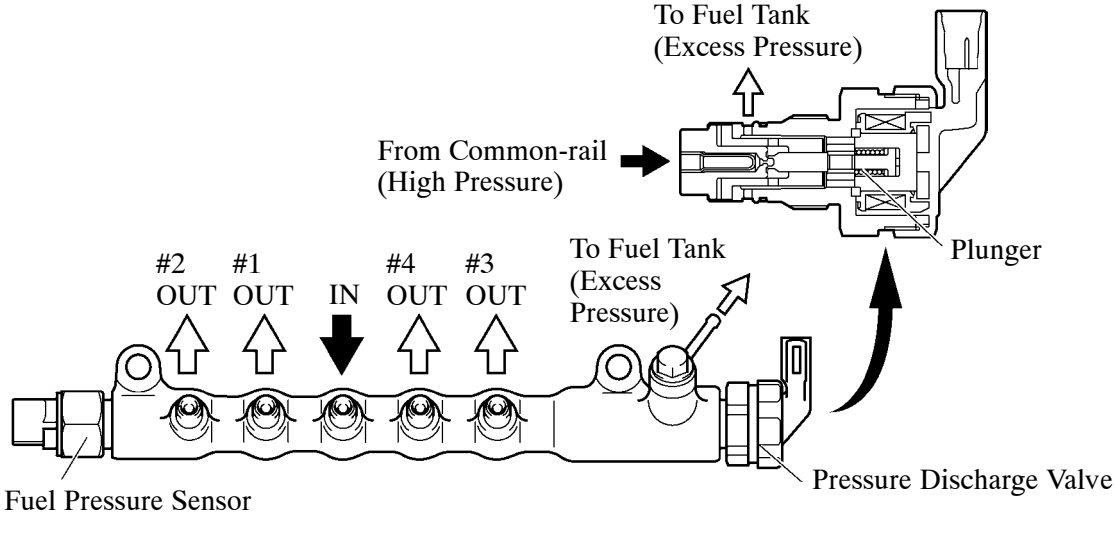
Supply Pump

- A exhaust fuel addition injector discharge port has been added to the supply pump feed pump which feeds high-pressure fuel in order to supply fuel to the exhaust fuel addition injector for PM combustion.



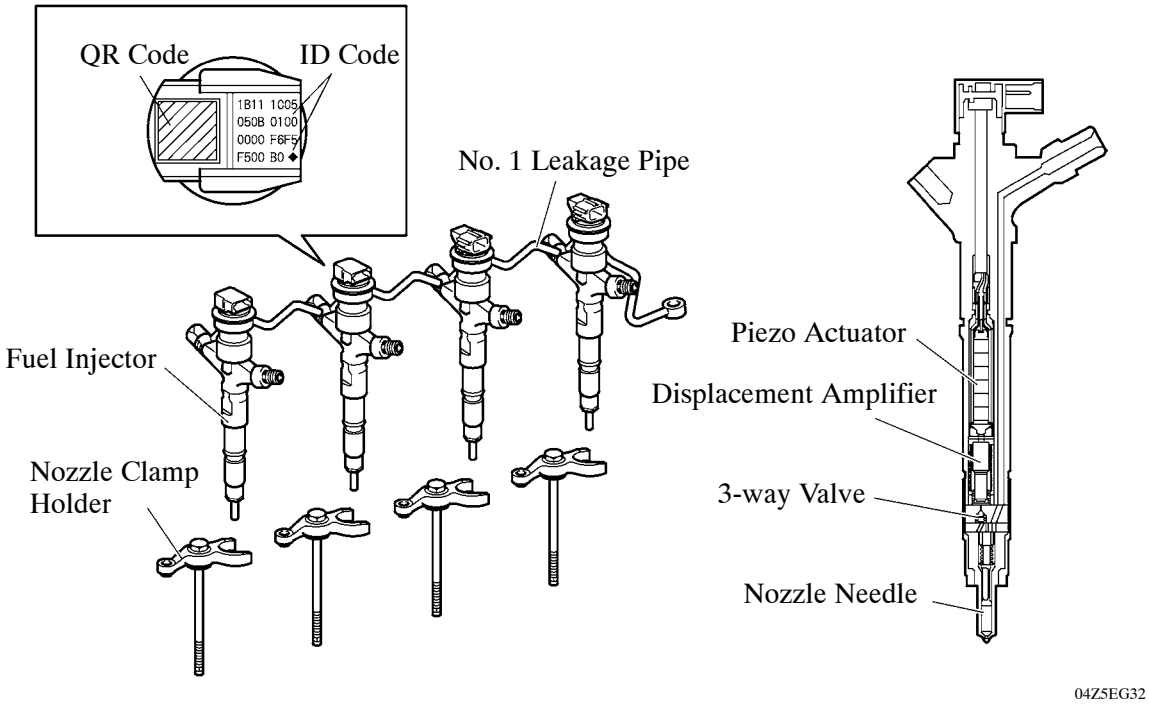
Common-rail

- The maximum common-rail fuel pressure has been increased from 180 MPa to 200 MPa. In combination with piezo type fuel injectors, this improves fuel injection accuracy and achieves greater fuel atomization.
- The common-rail shape and pressure discharge valve have been changed, and the connection of the leak fuel tube has been moved from the end of the pressure discharge valve to the common-rail.
- The storage of high pressure (0 – 200 MPa) in the rail has made electronic injection control with the injectors possible.



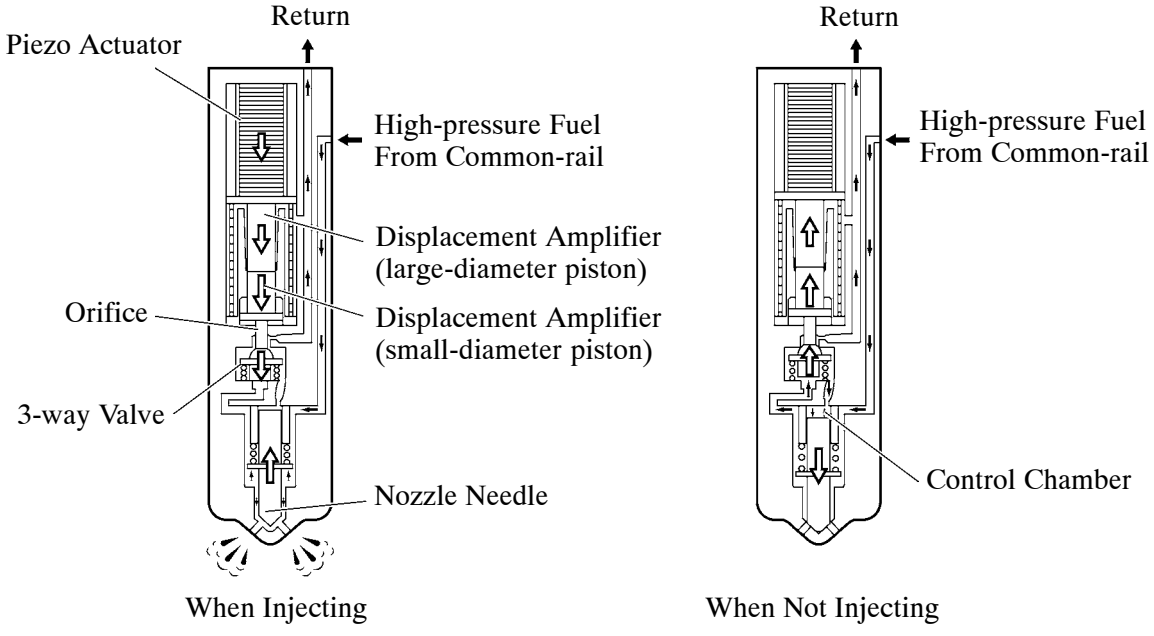
Injector

- The fuel injectors have been changed from solenoid valve control types to piezo actuator control types.
- A fuel injector is composed of the piezo actuator which controls the inflow and outflow of fuel, the displacement amplifier which amplifies the amount of piezo actuator operation, the 3-way valve which controls the nozzle needle, and the nozzle needle which opens and closes the discharge port.



1) Operation

- When the piezo actuator is not energized, the displacement amplifier and 3-way valve are pushed upward by the force of the spring, closing the orifice. When this happens, the high-pressure fuel from the common-rail flows into the control chamber, and together with the spring force pushes the nozzle needle downward. This closes the fuel injector nozzle needle, preventing fuel injection.
- When the piezo actuator is energized, the 3-way valve is pushed downward via the displacement amplifier, opening the orifice. When this happens, the fuel pressure in the control chamber disappears, and the high-pressure fuel from the common-rail exceeds the spring force, causing the fuel in the control chamber to flow out to the return side. This pushes the nozzle needle upwards and starts injection.



9. Engine Control System

General

The following list shows a comparison of the engine control systems of the 1KD-FTV engine for the Hong Kong package models and the 1KD-FTV engine for the Hong Kong package models.

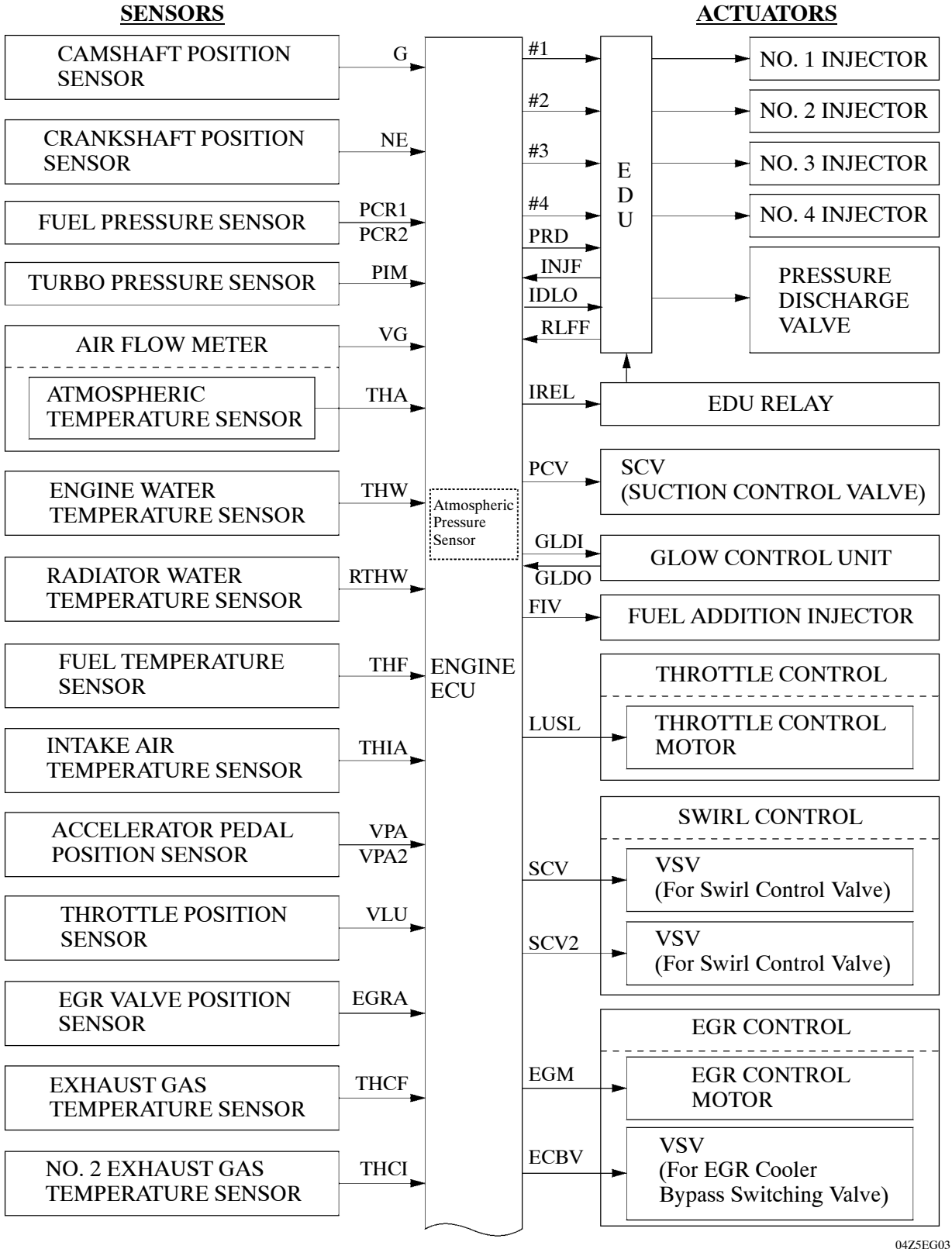
System		Outline	New Model	Previous Model
			1KD-FTV	1KD-FTV
Fuel Injection Volume Control		Based on the signals received from the sensors, the engine ECU determines the fuel injection volume in accordance with the engine condition. It also corrects the injection volume for each injector, based on the signals input from the crankshaft position sensor and the clutch switch, etc.	○	○
Fuel Injection Timing Control		Based on the signals received from the sensors, the engine ECU determines the fuel injection timing in accordance with the engine condition.	○	○
Fuel Pressure Control		Based on the signals received from the sensors, the engine ECU controls the fuel pressure using the SCV (Suction Control Valve) and pressure discharge valve in accordance with the engine condition.	○	○
Pilot Injection Control		Based on the signals received from the sensors, the engine ECU determines the pilot injection volume/timing, and the interval (between pilot injection and main injection) in accordance with the engine condition.	○	○
During Starting Control		To facilitate startability, the engine ECU optimally controls the injection volume and injection timing during starting.	○	○
Idle Speed Control		The engine ECU determines the idle speed in accordance with the engine condition, and controls the fuel injection volume in order to maintain the target idle speed.	○	○
Glow Plug Control (See Page 45)		A signal is sent to the glow control unit according to the engine conditions. This signal is used by the glow control unit to control the glow plug energizing time, in order to control the glow plug temperature for ideal combustion conditions.	○	—
		Controls the length of time that the current is applied to the glow plugs, in accordance with the water temperature.	—	○
DPF System (See Page 44)	Control during normal driving	When the temperature of the DPF catalyst is sufficiently high, PM purification occurs continuously. The effects of the DPF catalyst and oxidation catalyst also purify CO and HC.	○	—
	Control during forced PM regeneration	When the PM accumulation in the DPF catalyst exceeds the standard value, the catalyst temperature is forcibly raised in order to oxidize the PM.	○	—

(Continued)

System	Outline	New Model	Previous Model
		1KD-FTV	1KD-FTV
Throttle Control	Based on the signals received from the various sensors, the engine ECU determines the throttle valve position in accordance with the engine condition.	○	○
	Fully close the throttle valve in order to reduce the vibration when the engine is stopped.	○	○
Swirl Control (See Page 40)	Based on the signal received from the sensors, the engine ECU controls the vacuum to 3-stage using two VSVs.	○	—
	Based on the signal received from the sensors, the engine ECU controls the vacuum to 2-stage using one VSV.	—	○
Turbocharger Control	Based on the signals received from the sensors, the engine ECU controls the actuator in accordance with the engine condition.	○	○
EGR Control (See Page 43)	Based on the signals received from the sensors, the engine ECU determines the EGR volume using the EGR valve, EGR cooler bypass switching valve and throttle valve in accordance with the engine condition.	○	○
Oil Pump Control (See Page 45)	Based on information concerning the engine coolant temperature, engine speed, amount of fuel injection, and engine oil pressure, the engine control computer controls the oil pressure in 2 stages.	○	—
Diagnosis	When the engine ECU detects a malfunction, it diagnoses and memorizes the malfunctioning section.	○	○
Fail-safe	When the engine ECU detects a malfunction, it stops or controls the engine according to the data already stored in the memory.	○	○

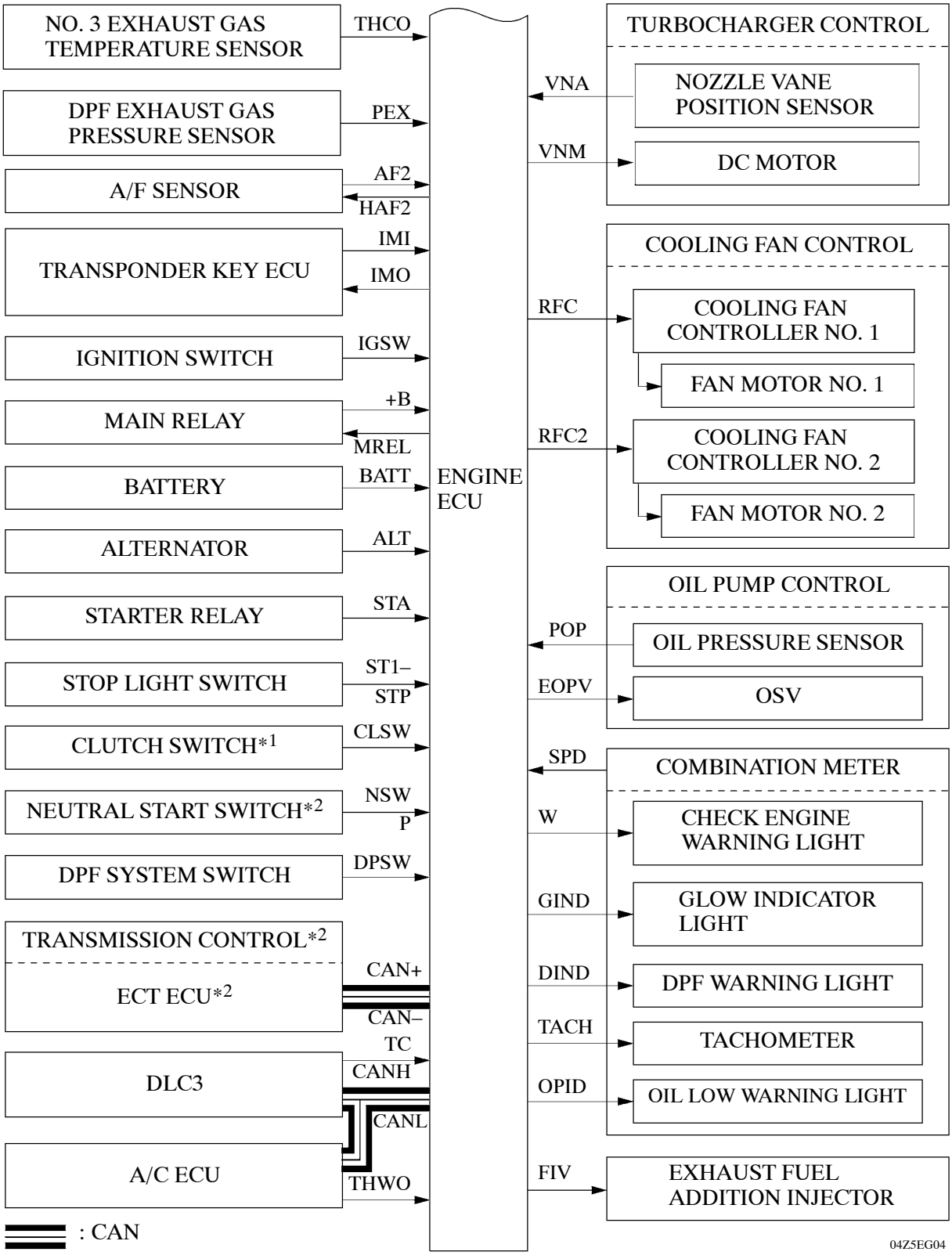
Construction

The configuration of the 1KD-FTV engine control system is as shown in the following chart.



04Z5EG03

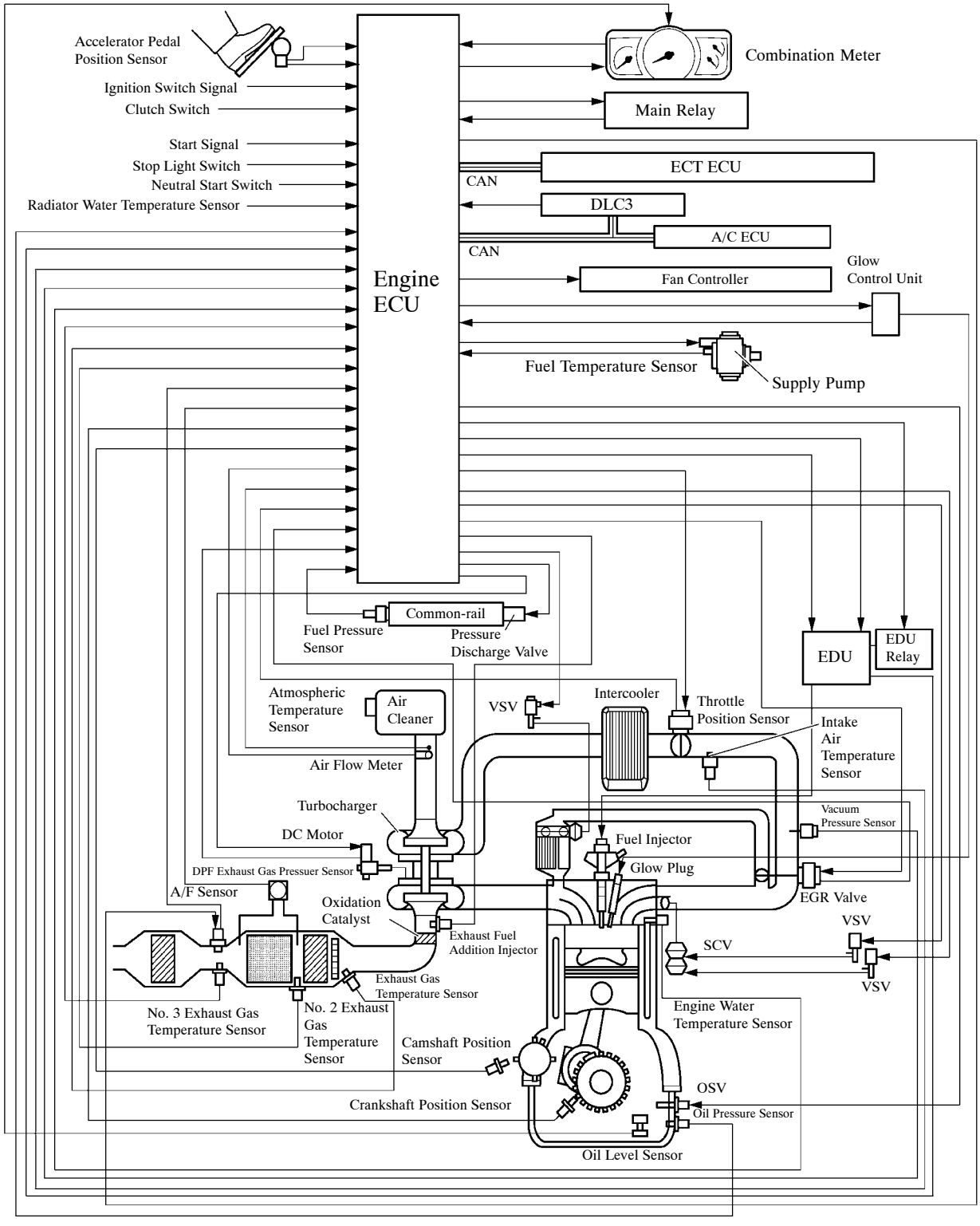
(Continued)



*1: Models of Manual Transmission
*2: Models of Automatic Transmission

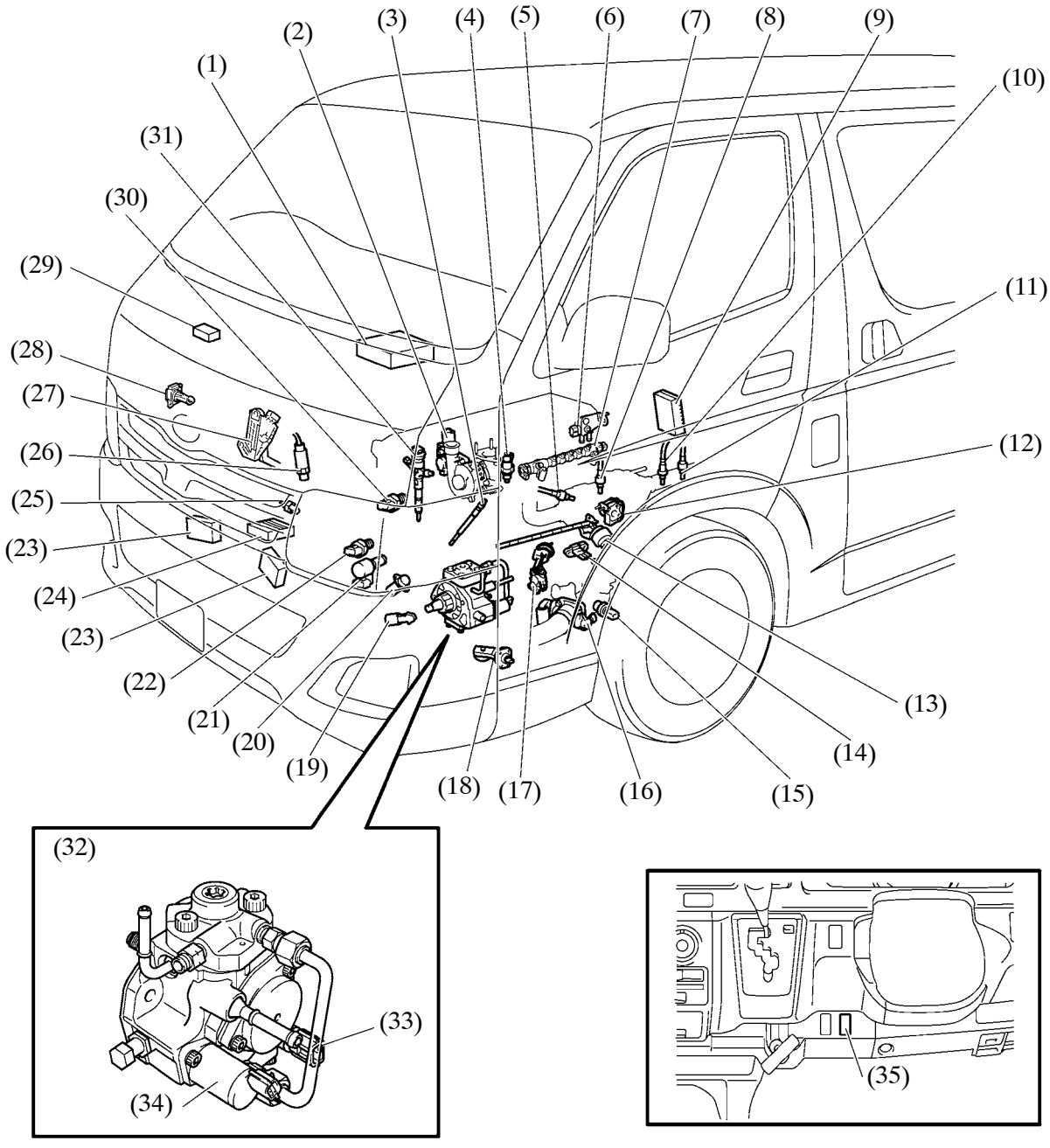
NF

Engine Control System Diagram



04Z5EG02

Layout of Main Components



04Z5EG01

No.	Parts Name	No.	Parts Name
(1)	Engine ECU	(2)	Nozzle Vane Position Sensor
(3)	Glow Plug	(4)	Exhaust Fuel Addition Injector
(5)	Exhaust Gas Temperature Sensor	(6)	DPF Exhaust Gas Pressure Sensor
(7)	Fuel Pressure Sensor	(8)	No. 2 Exhaust Gas Temperature Sensor
(9)	Glow Control Unit	(10)	A/F Sensor
(11)	No. 3 Exhaust Gas Temperature Sensor	(12)	EGR Valve
(13)	Swirl Control Valve	(14)	Turbo Pressure Sensor
(15)	Intake Air Temperature Sensor	(16)	Throttle Body
(17)	VSV(For EGR Cooler Bypass Switching Valve Control)	(18)	Oil Level Sensor
(19)	Camshaft Position Sensor	(20)	Crankshaft Position Sensor
(21)	OSV	(22)	Oil Pressure Sensor
(23)	Cooling Fan Controller	(24)	EDU
(25)	Radiator Water Temperature Sensor	(26)	Clutch Switch
(27)	Accelerator Pedal Position Sensor	(28)	Air Flow Meter (Atmospheric Temperature Sensor)
(29)	DLC3	(30)	Engine Water Temperature Sensor
(31)	Injector	(32)	Supply Pump
(33)	Fuel Temperature Sensor	(34)	SCV
(35)	DPF System Switch	—	—

Main Components of Engine Control System

1) General

The main components of the 1KD-FTV engine control system are as follows:

Model	New HIACE (EURO V C/D mode)		Previous HIACE (EURO IV C/D mode)	
Component	Outline	Quantity	Outline	Quantity
Engine ECU	32-bit CPU	1	←	←
EDU	DC/DC Converter	1	←	←
Turbo Pressure Sensor	Semiconductor Silicon Chip Type	1	←	←
Atmospheric Pressure Sensor	Semiconductor Silicon Chip Type	1	←	←
Fuel Pressure Sensor	Semiconductor Strain Gauge Type	1	←	←
Crankshaft Position Sensor	Pick-up Coil Type (Rotor Teeth/36 - 2)	1	←	←
Camshaft Position Sensor	Pick-up Coil Type (Rotor Teeth/5)	1	←	←
Air Flow Meter	Hot-wire Type (Digital Type)	1	←	←
Atmospheric Temperature Sensor	Thermistor Type	1	←	←

(Continued)

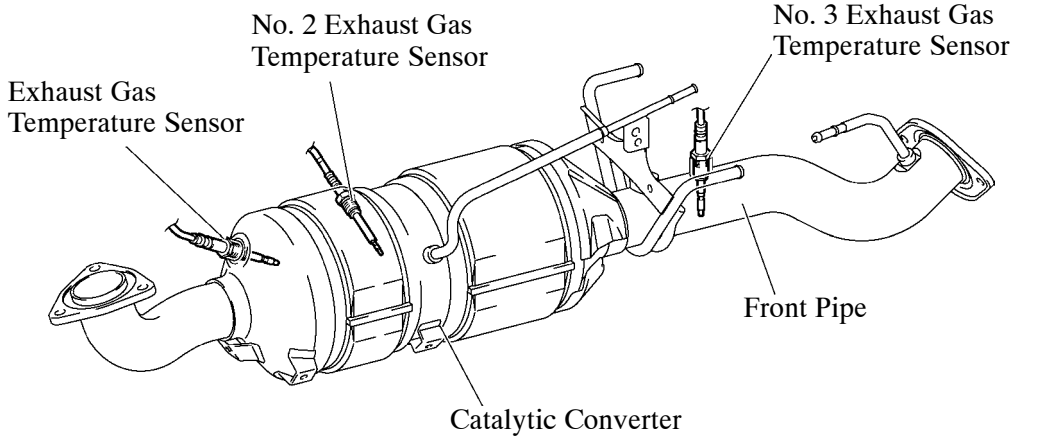
Model	New HIACE (EURO V)		Previous HIACE (EURO IV C/D mode)	
Component	Outline	Quantity	Outline	Quantity
Water Temperature Sensor	Thermistor Type	1	←	←
Intake Air Temperature Sensor	Thermistor Type	1	←	←
Fuel Temperature Sensor	Thermistor Type	1	←	←
Exhaust Gas Temperature Sensor	Thermistor Type	1	—	—
No. 2 Exhaust Gas Temperature Sensor	Thermistor Type	1	—	—
No. 3 Exhaust Gas Temperature Sensor	Thermistor Type	1	—	—
DPF Exhaust Gas Pressure Sensor	Semiconductor Strain Ganged Type	1	—	—
A/F Sensor	Planar Type with Heater	1	—	—
Throttle Position Sensor	Non-contact Type	1	←	←
Accelerator Pedal Position Sensor	Non-contact Type	1	←	←
EGR Valve Position Sensor	Non-contact Type	1	Contact Type	←
SCV (Suction Control Valve)	Linear Solenoid Valve	1	←	←
Fuel Injectors	Piezo Type (10-hole Type)	1	8-hole Type (High-response)	1
Exhaust Fuel Addition Injector	Solenoid Type	1	—	—

2) Intake Air Temperature Sensor

- The position where the intake air temperature sensor is installed has been changed from the previous position on the upstream side of the intake throttle valve to a position on the downstream side. The same intake air temperature sensor unit continues to be used.

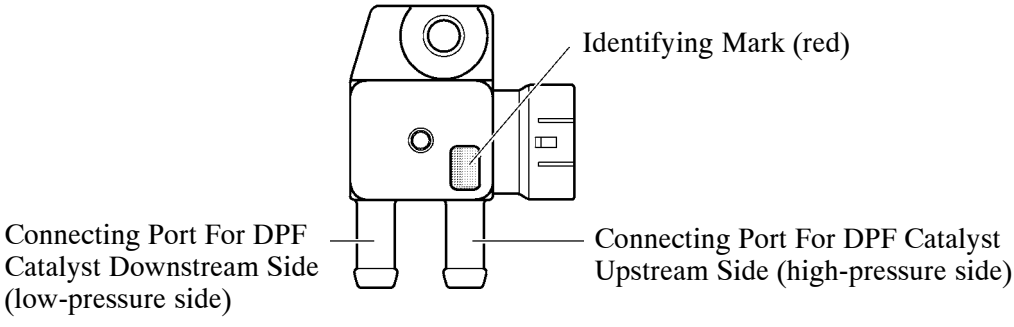
3) Exhaust Gas Temperature Sensor

- Exhaust gas temperature sensors have been added to the front pipe. This improves the control accuracy of the DPF system.



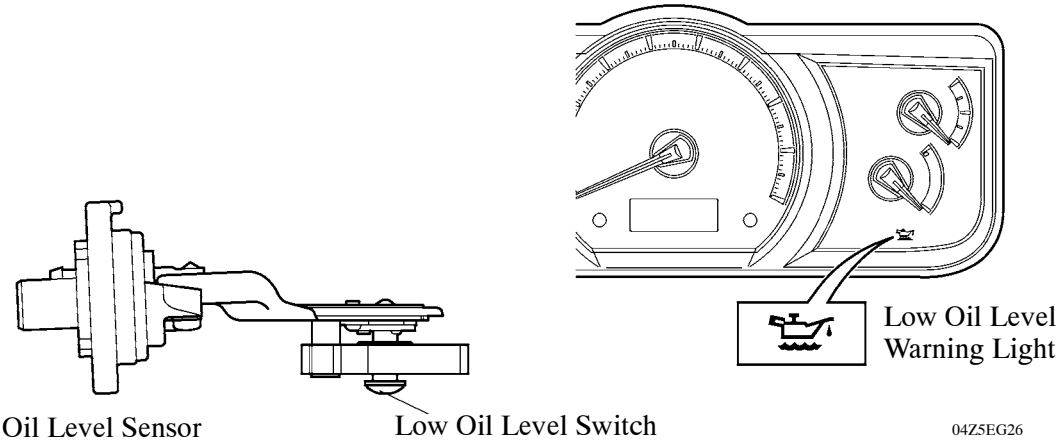
4) DPF Exhaust Gas Pressure Sensor

- The exhaust gas pressure sensor which performs detection for estimating the amount of PM accumulation in the DPF catalyst and for judging when clogging has occurred has been changed from an absolute pressure detection type on the upstream side of the DPF catalyst to a differential pressure type upstream and downstream of the DPF catalyst.
- The differential pressure type exhaust gas pressure sensor has a connecting port for the high-pressure side and low-pressure side. The high-pressure side is connected on the upstream side of the DPF, and the low-pressure side is connected on the downstream side, allowing the difference in exhaust gas pressure between the DPF entrance and exit to be detected. There are identifying marks on the exhaust gas pressure sensor connecting ports to prevent incorrect assembly.



5) Oil level Sensor

- The oil level sensor includes a low oil level switch which turns ON the low oil level warning light when the engine oil level is below the prescribed level.

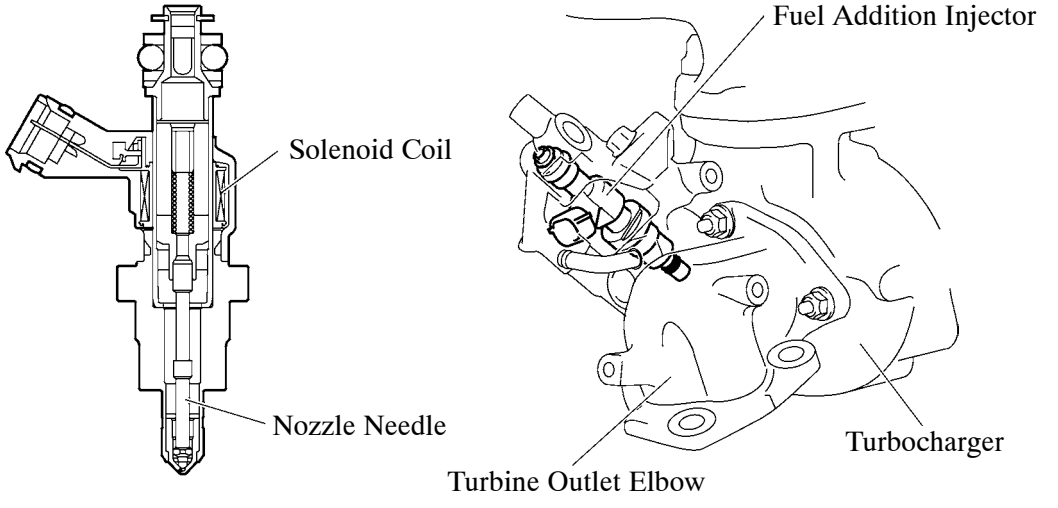


Conditions for turning ON the low oil level warning light

Low oil level switch	Low oil level warning light
Turns ON for the prescribed number of times or more within the prescribed time	Turns ON

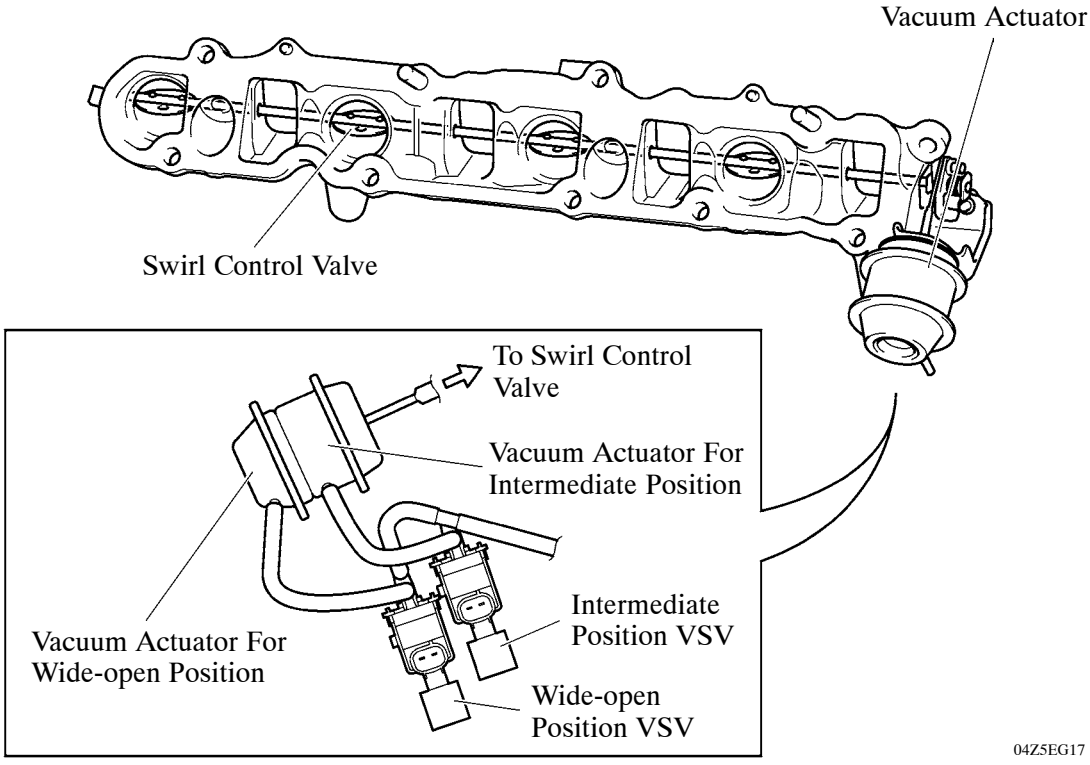
6) Exhaust Fuel Addition Injector

- An exhaust fuel addition injector has been adopted for injecting fuel during forced PM regeneration.
- The exhaust fuel addition injector injects fuel into the exhaust pipe during forced PM regeneration based on control from the engine control computer.



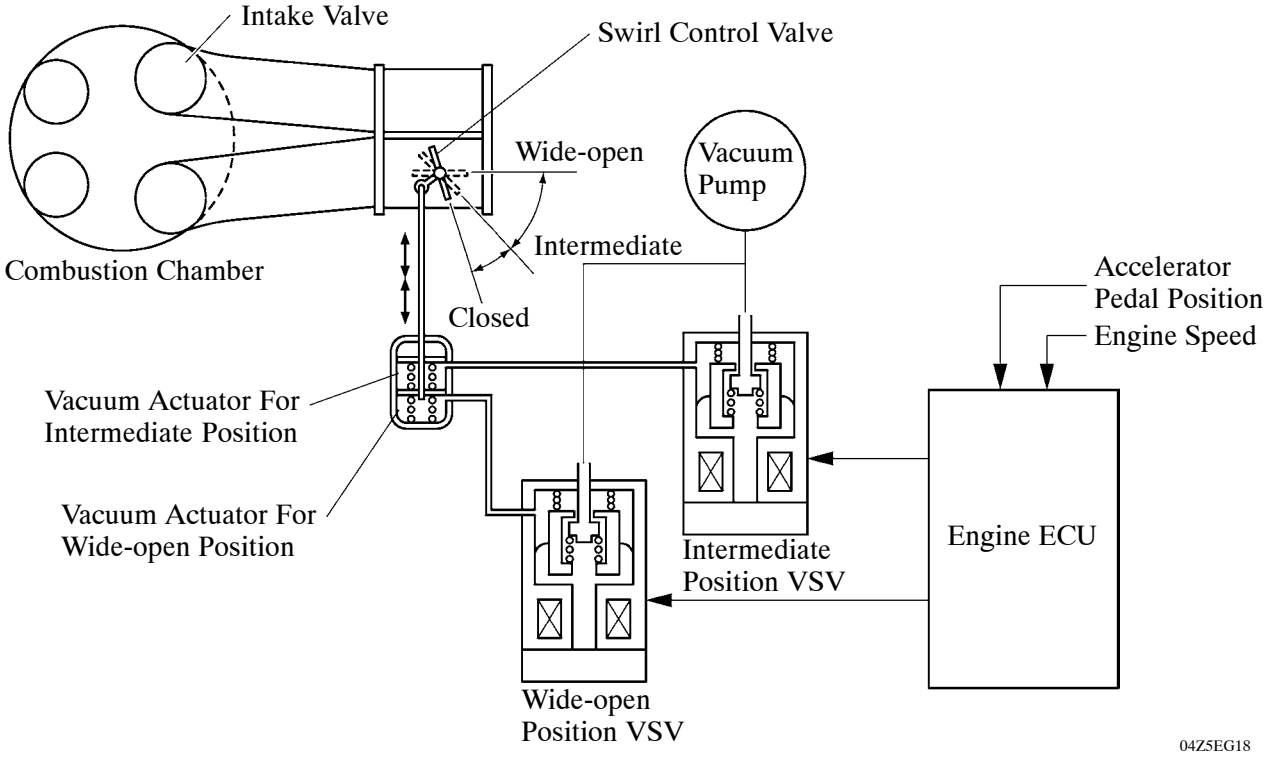
Swirl Control

- The swirl control valve has been changed from the intake manifold to an independent position. The swirl control valve position can be controlled in 3 stages, allowing the swirl ratio to be changed in 3 stages in low- and mid-speed ranges.
- Due to the adoption of a 3-stage swirl control valve, the vacuum actuator has been changed to a 2-stage type. Two VSV which operate the vacuum actuator have been set, one for the wide-open position and one for the intermediate position.



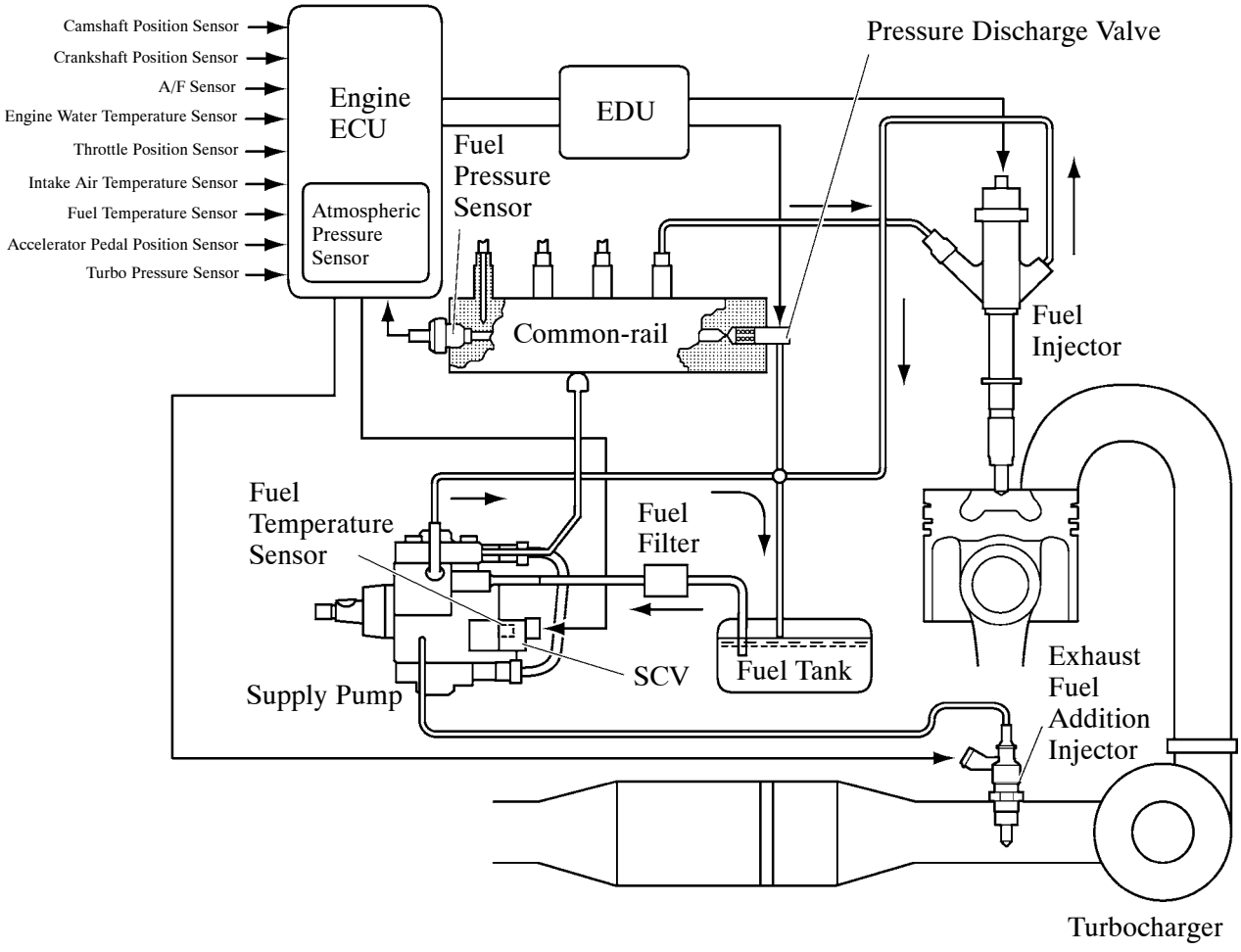
1) Swirl Control Valve Operation

- The engine control computer determines the valve position (wide-open, intermediate, or closed) based on the engine status (engine speed, throttle position), and switches the vacuum pressure applied to the vacuum actuator diaphragm chamber via the 2 VSVs in order to open and close the valve.
- In low-speed ranges, the valve is closed and the swirl inside the cylinder is strengthened. In mid-speed ranges, the intermediate position is used, controlling the mixture of fuel and air to ensure stable combustion. This succeeds in reducing smoke.
- The swirl control valve has been removed from the intake manifold and made independent, increasing the EGR gas mixing distance. This reduces variation between cylinders, and reduces emissions.



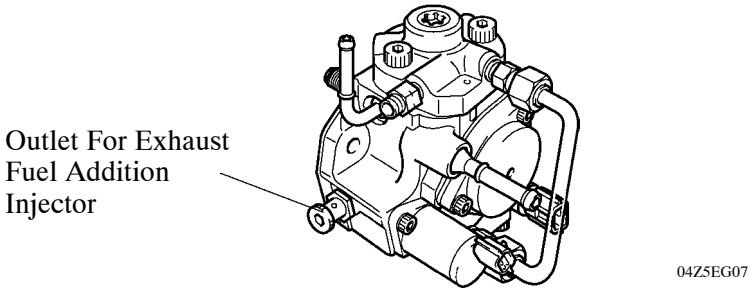
Fuel Injection Control

- The engine control computer sends a signal to the injector piezo actuator via the EDU (Electric Driver Unit) to control the timing and amount of the fuel to be injected.
- By controlling the common-rail pressure to the optimal pressure (maximum approx. 200 MPa), the necessary fuel pressure for injectors to inject fuel is maintained at all times.
- The fuel injectors have been changed to a piezo actuator type, and the discharge pressure of the supply pump has been increased (maximum approx. 200 MPa). This further atomizes the injected fuel for more stable combustion.
- An exhaust fuel addition injector (for PM combustion) is placed on the rear of the turbocharger, and fuel is injected when forced DPF regeneration occurs.



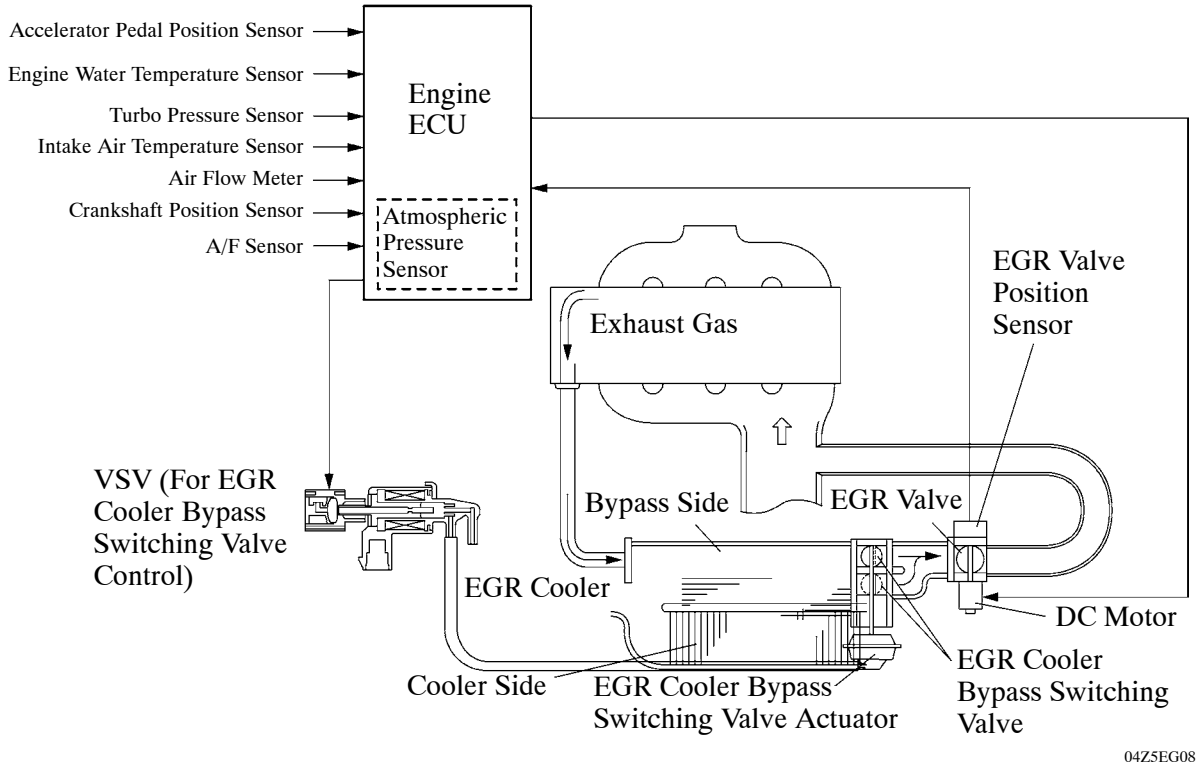
Supply Pump Control

- An exhaust fuel addition injector discharge port has been added to the supply pump feed pump which feeds high-pressure fuel in order to supply fuel to the exhaust fuel addition injector that is used for PM combustion.
- Piezo fuel injectors and a common-rail compatible with high-pressure fuel of up to 200 MPa have been adopted, and as a result the supply pump discharge pressure has been changed to maximum 200 MPa. The method of feeding high-pressure fuel remains the same as before.
- The fuel discharge pressure from the exhaust fuel addition injector discharge port is approx. 1 MPa.



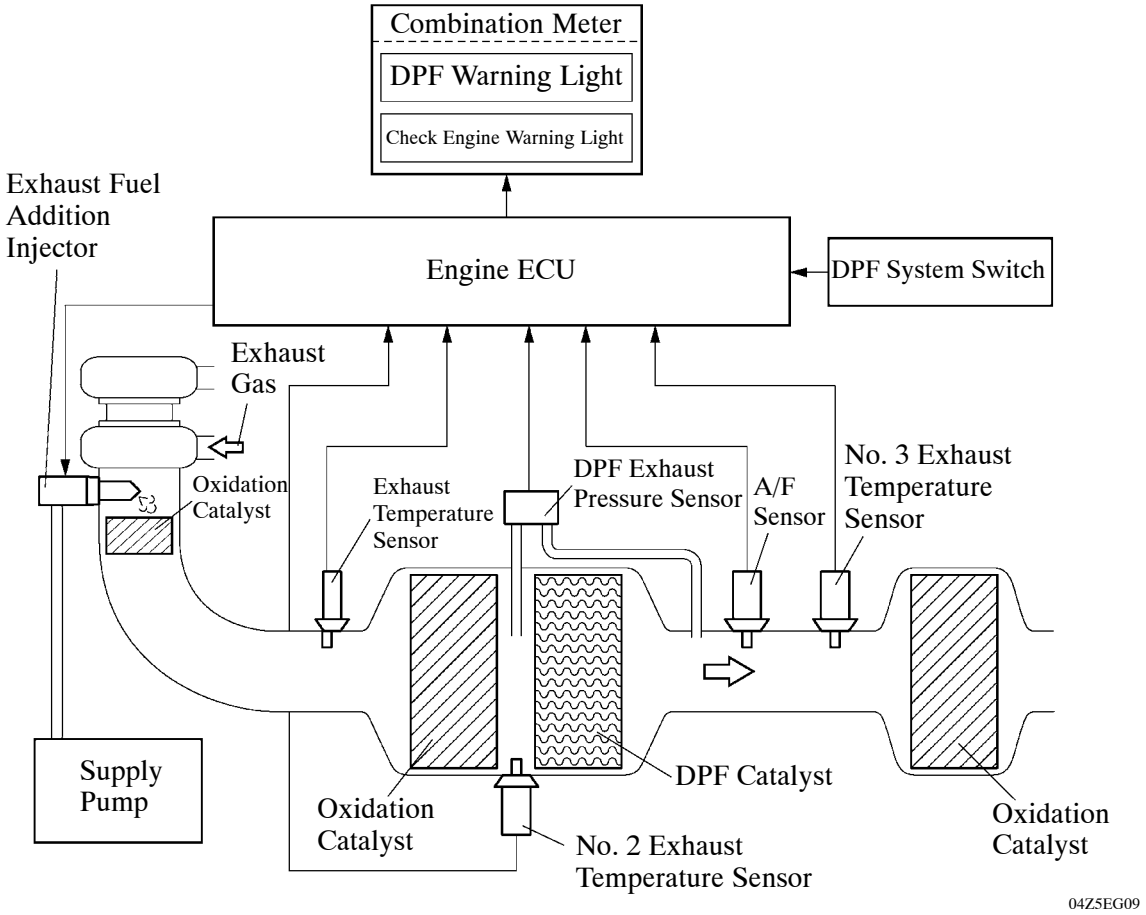
EGR Control

- The EGR valve was changed to a combination of DC motor and butterfly valve, reducing airflow resistance and increasing the valve opening. This increases the EGR amount and improves control performance. As a result, the EGR valve lift sensor has been eliminated, and an EGR valve position sensor located inside the EGR valve is used.
- An EGR cooler with integrated bypass has been adopted. The EGR cooler uses a straight structure in order to reduce pressure loss. In addition, an EGR cooler bypass valve has been placed on the EGR cooler exit side, and switching of the EGR cooler channel between the bypass side and cooler side is controlled by the engine control computer, making it possible to vary the EGR gas temperature.



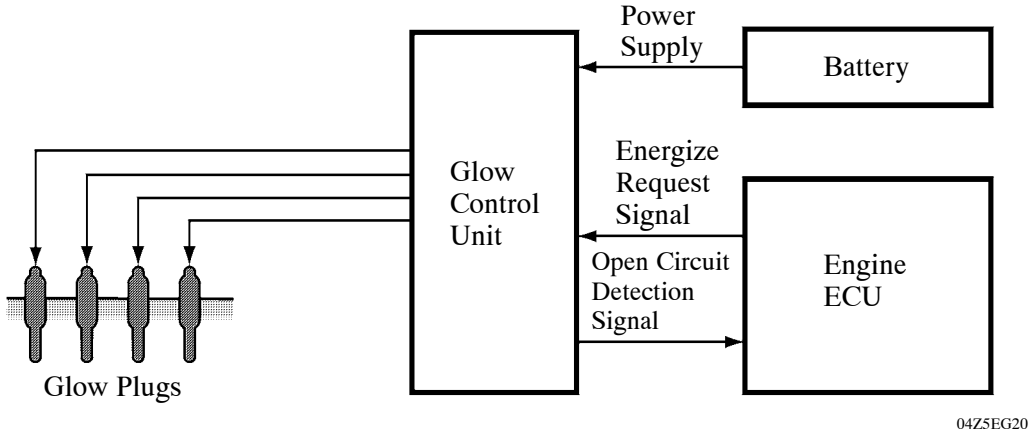
DPF System

- If the DPF catalyst temperature is high under normal driving conditions, PM captured by the DPF catalyst is oxidized by the temperature of the DPF catalyst and is emitted as CO_2 and H_2O.
- If the DPF catalyst temperature becomes low, catalyst performance decreases, resulting in an increase of the amount of PM stuck in the filter substrate. The engine ECU detects that the filter substrate is clogged by calculating the accumulated volume of the PM discharged by the engine. To reduce PM, the engine ECU controls the injection timing and the injection frequency of the injectors, and activates the exhaust fuel addition injector. At the same time, engine ECU controls the engine speed and glow plug assembly temperature via the glow plug controller.
- As a result, filter substrate temperature becomes high and PM reacts with active oxygen and changes into CO_2 for purification.
- When PM has accumulated in the DPF catalyst while driving normally, the engine ECU automatically performs catalyst support control.
- However, sufficient purification of the PM by the catalyst support control may not be possible when driving repeatedly over short distances. As a result, the PM accumulation limit may be surpassed. If catalyst support control is conducted in this situation, the DPF catalyst could be destroyed. To prevent this, the engine ECU calculates the level of PM accumulation. If a predetermined level has been surpassed, the DPF indicator in the combination meter and the DPF system switch indicator are illuminated, stop the vehicle in a safe place and then, press the DPF system switch.
- Moreover, if the driver keeps driving without either bringing the vehicle to a dealer or driving at a constant speed, the MIL will be illuminated when a predetermined driving distance is reached. At the same time, the engine ECU changes the engine control to the fail-safe mode, thus controlling the amount of fuel injection to a minimum.



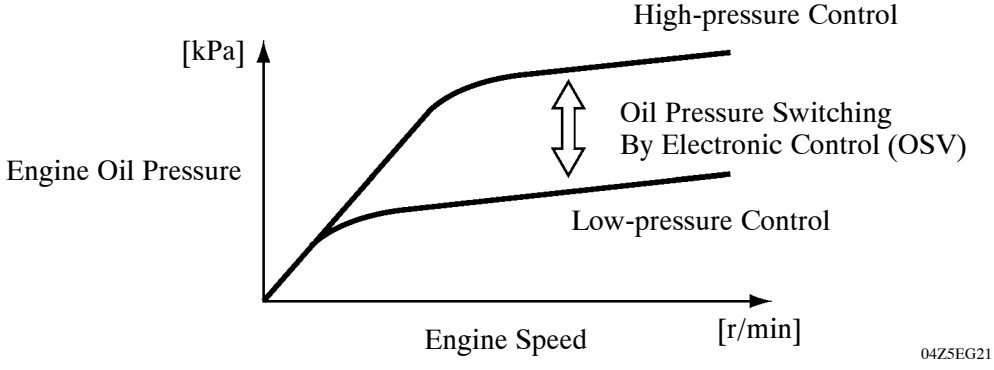
Glow Plug Control

- A glow control unit which controls the energizing of the glow plugs has been adopted and the glow relay has been eliminated. The glow control unit independently energizes the glow plug of each cylinder according to the energize request signal from the engine control computer. This allows precise glow plug temperature control.
- When the energize request signal from the engine control computer is input into the glow control unit, the unit energizes the glow plugs while staggering the timing for each cylinder, controlling the temperature inside the cylinders to the optimal temperature.
- When the ignition switch and starter signal turn ON, the engine control computer sends the energize request signal to the glow control unit and the glow control unit rapidly heats the glow plugs. The engine control computer also turns ON the glow indicator light on the combination meter, informing the driver of the glow status.
- When the starter signal turns OFF and the engine starts, after-glow control is performed.



Oil Pump Control

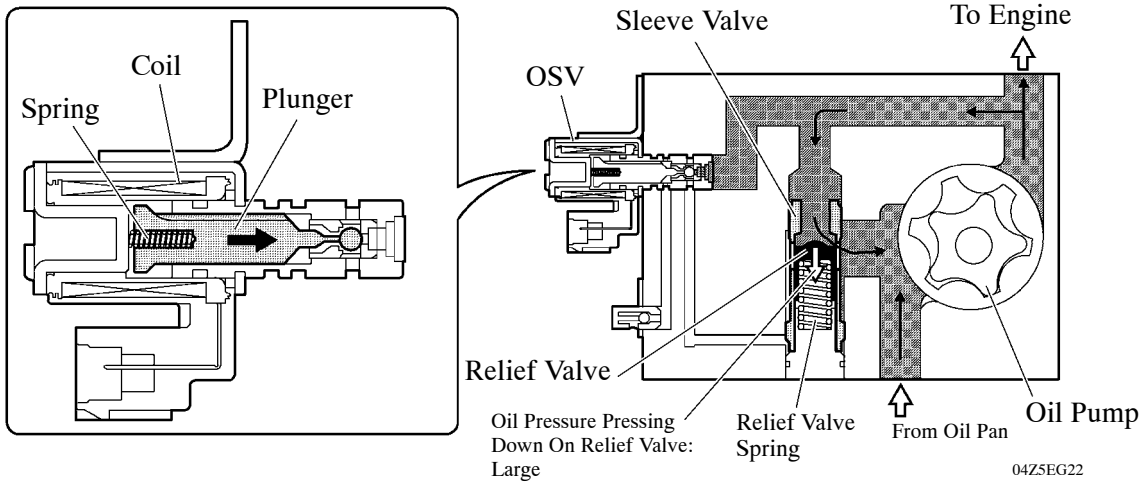
- An oil pump with variable discharge pressure that allows the engine oil pressure to be controlled in 2 stages according to the vehicle driving conditions has been adopted. Therefore, energy loss due to the driving of the oil pump has been reduced and fuel economy has been improved.
- The mechanism for control of the oil pump with variable discharge pressure is composed of a relief valve which returns the engine oil discharged from the oil pump to the oil pan and an OSV which varies the position of the relief valve. Based on information concerning the engine coolant temperature, engine speed, amount of fuel injection, and engine oil pressure, the engine control computer controls the oil pressure in 2 stages.



1) Operation of oil pump with variable discharge pressure

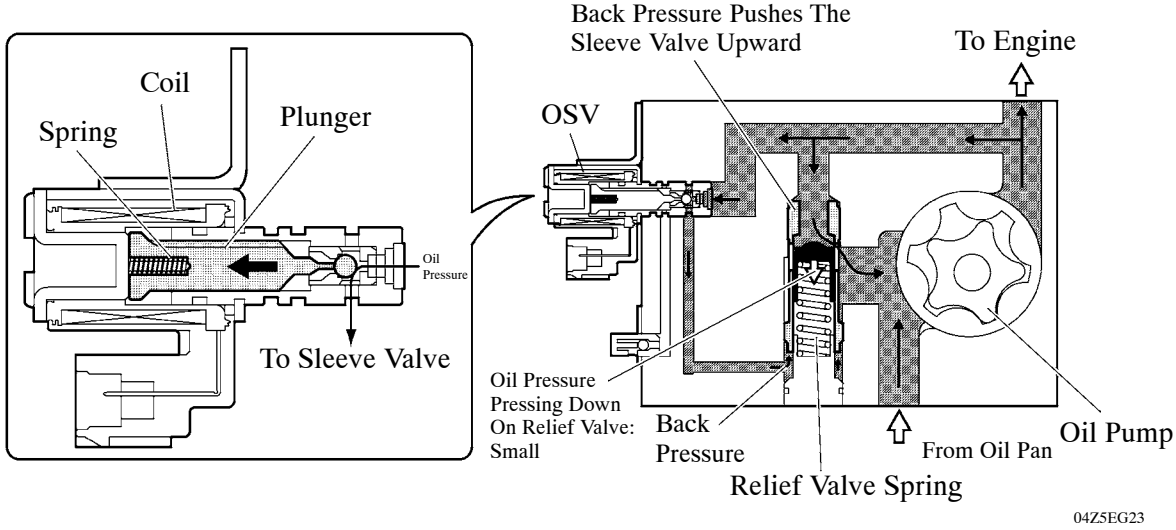
a. High pressure operation

- When the OSV is not energized, the spring inside the OSV presses against the plunger, shutting off the oil channel, and preventing oil pressure from acting on the bottom of the sleeve valve.
- Because no oil pressure is applied, the sleeve valve is pressed down as shown in the figure, and the oil channel on the side of the sleeve valve is also pressed down. As a result, the oil pressure generated by the oil pump compresses the relief valve spring via the relief valve, increasing the oil pressure which forms a channel for oil return to the oil pan side. This controls the engine oil pressure at high pressure.



b. Low pressure operation

- When the OSV is energized, the coil inside the OSV pulls the plunger and opens the oil channel, applying pressure to the bottom of the sleeve valve.
- When oil pressure (back pressure) is applied to the sleeve valve, the valve is pushed upward as shown in the figure, and the oil channel in the side of the sleeve valve is also pushed upward. As a result, the oil pressure generated by the oil pump compresses the relief valve spring via the relieve valve, reducing the amount of the oil pressure that forms the channel which returns oil to the oil pan side. This controls the engine oil pressure at low pressure.



Diagnosis

- In accordance with the changes to the engine control system, some DTCs (Diagnostic Trouble Codes) have been added and others have been changed. For details, refer to the HIACE Repair Manual.