

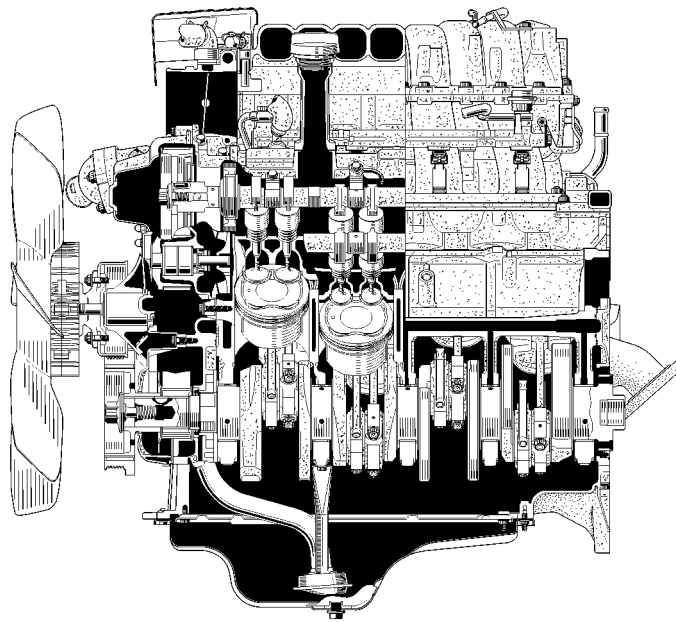
ENGINE

2UZ-FE ENGINE

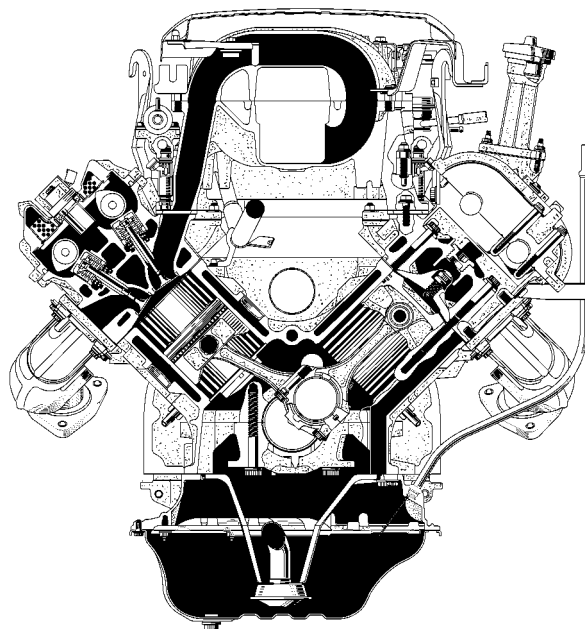
■ DESCRIPTION

The engine on the Sequoia is the 2UZ-FE engine that supports the U-LEV (Ultra-Low Emission Vehicle) requirements. It is based on the 2UZ-FE engine, which is a V8, 4.7-liter, 32-valve DOHC engine that is equipped on the '00 Toyota Tundra.

This engine has been developed to realize high performance, quiet operation, and fuel economy. In addition, it has adopted the ETCS-i (Electronic Throttle Control System-intelligent) to ensure excellent controllability of the vehicle and to improve its comfort.



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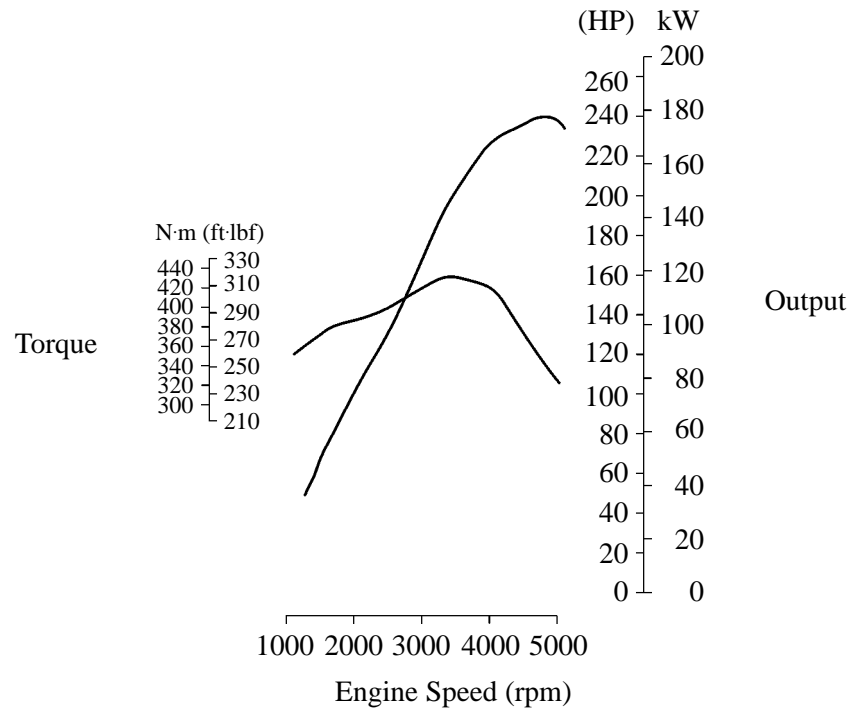


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• Specification ◀

Engine Type		2UZ-FE	
No. of Cyls. & Arrangement		8-Cylinder, V Type	
Valve Mechanism		32-Valve DOHC, Belt & Gear Drive	
Combustion Chamber		Pentroof Type	
Manifolds		Cross-Flow	
Fuel System		SFI	
Displacement	cm ³ (cu.in.)	4664 (284.5)	
Bore x Stroke	mm (in.)	94.0 x 84.0 (3.70 x 3.31)	
Compression Ratio		9.6 : 1	
Max. Output		(SAE-NET)	179 kW @ 4800 rpm (240 HP @ 4800 rpm)
Max. Torque		(SAE-NET)	427 N·m @ 3400 rpm (315 ft·lbf @ 3400 rpm)
Valve Timing	Intake	Open	3° BTDC
		Close	36° ABDC
	Exhaust	Open	46° BBDC
		Close	3° ATDC
Fuel Octane Number		RON	91 or More
Oil Grade		API SJ, EC or ILSAC	

• Performance Curve ◀



■ FEATURE OF 2UZ-FE ENGINE

The 2UZ-FE engine has been able to achieve the following performance through the adoption of the items listed below.

- (1) High performance and fuel economy
- (2) Low noise and vibration
- (3) Lightweight and compact design
- (4) Good serviceability
- (5) Clean emission

Item	(1)	(2)	(3)	(4)	(5)	'01 Sequoia	'00 Toyota Tundra
An upright intake port has been adopted to improve the intake efficiency.	•					•	•
A taper squish configuration has been adopted to improve the combustion efficiency.	•				•	•	•
A steel laminate type cylinder head gasket has been adopted to ensure its reliability.				•		•	•
An aluminum oil pan that is integrated with stiffeners has been adopted to reduce noise and vibration.		•				•	•
The skirt portion of the piston has been applied with tin plating to reduce friction.	•	•				•	•
Inner shim type valve lifters have been adopted.	•		•			•	•
Large-diameter intake and exhaust valves have been adopted to reduce the intake and exhaust resistance.	•				•	•	•
The automatic transmission oil cooler has been adopted to the multi-plate aluminum type.	•					•	•
The method for installing the radiator reservoir tank has been simplified and its overflow pipe has been integrated with the radiator reservoir tank.			•			•	•
A long port intake manifold is used to improve the engine's torque in the low-to mid speed range.	•					•	•
Performance and serviceability have been improved by optimizing the shape of the air cleaner.	•			•		•	•
The main muffler has adopted a dual inlet pipe configuration to reduce exhaust resistance.	•					•	-
4-hole type fuel injectors have been adopted to improve the atomization of fuel.	•				•	•	•
A compact fuel filter has been adopted for weight reduction.			•			•	•
The DIS (Direct Ignition System) makes ignition timing adjustment unnecessary.	•			•	•	•	•
A service port has been provided for inspecting the evaporative emission control system.				•		•	•
The vacuum type has been adopted to detect leaks in the evaporative emission control system.				•	•	•	-
ETCS-i has been adopted to realize excellent controllability and comfort of the vehicle.	•					•	•
A DTC (Diagnostic Trouble Code) P0128 has been added for indicating a thermostat malfunction. For details, refer to the 2001 Sequoia Repair Manual (Pub. No. RM832U).				•		•	-

◀ENGINE CONTROL SYSTEM

1. General

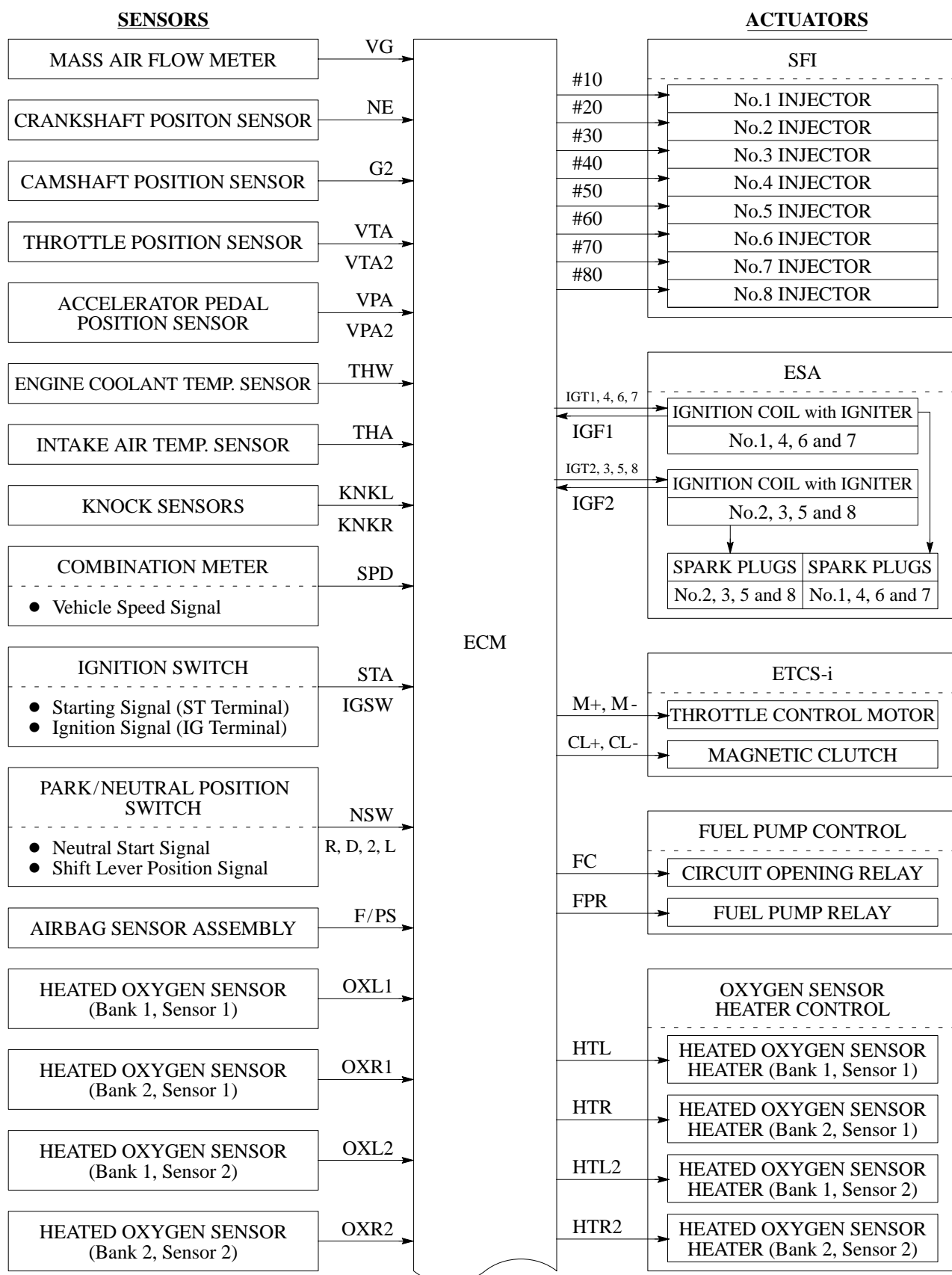
In addition to the SFI (Sequential Multiport Fuel Injection) system and the ESA (Electronic Spark Advance) system, the ETCS-i (Electronic Throttle Control System-intelligent) has been adopted in the engine control system to realize excellent vehicle maneuverability and comfort. Also, the cruise control system and the engine immobiliser system have been integrated in the ECM.

The engine control system of the Sequoia's 2UZ-FE engine and '00 TOYOTA Tundra's 2UZ-FE engine are compared below.

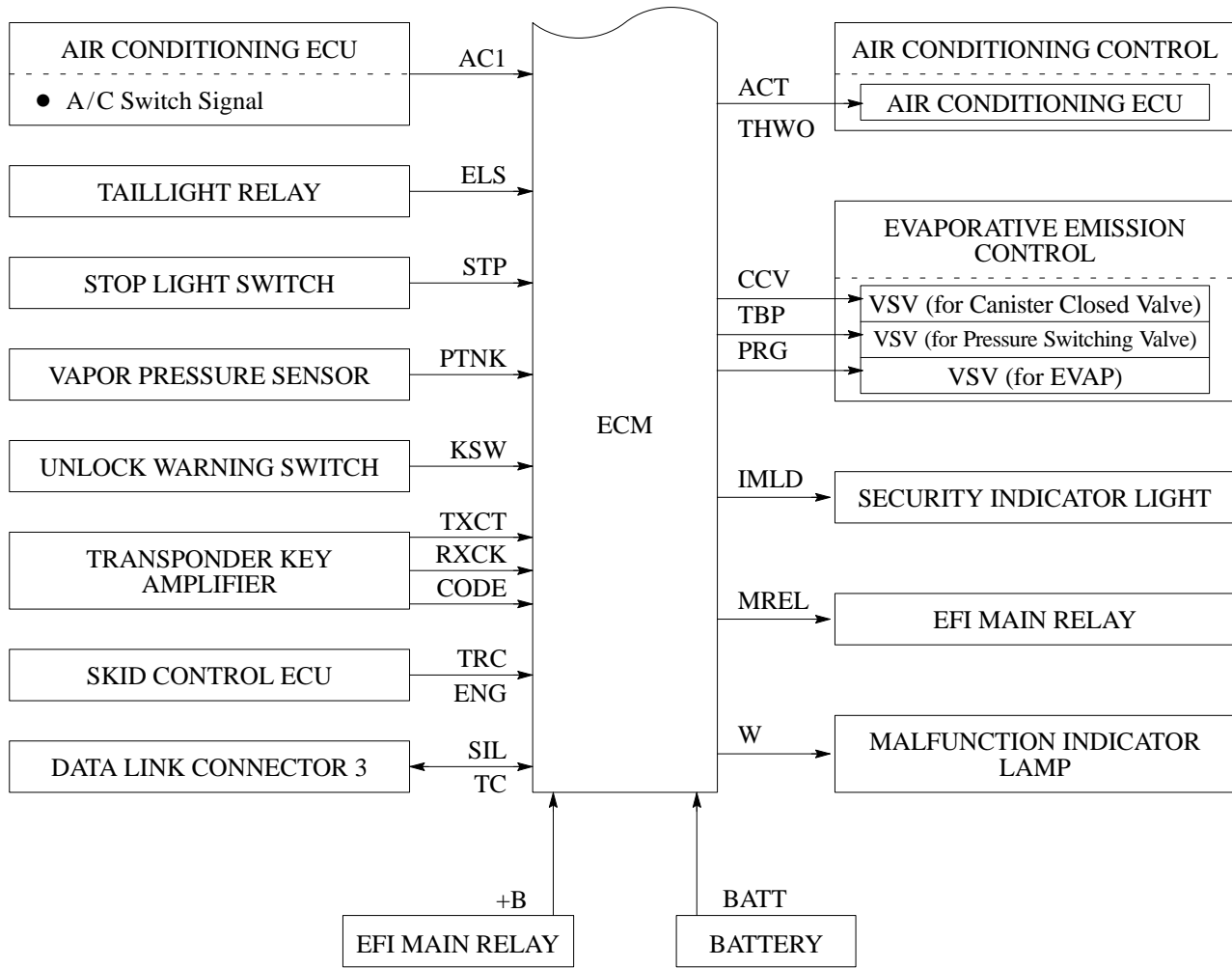
System	Outline	'01 Sequoia	'00 Toyota Tundra
SFI (Sequential Multiport Fuel Injection)	An L-type SFI system directly detects the intake air volume with a hot-wire mass air flow meter.	■	■
ESA (Electronic Spark Advance)	<ul style="list-style-type: none"> Ignition timing is determined by the ECM based on signals from various sensors. Corrects ignition timing in response to engine knocking. The torque control correction during gear shifting has been used to minimize the shift shock. 2 knock sensors are used to further improve knock detection. 	■	■
ETCS-i (Electronic Throttle Control System-intelligent)	Optimally controls the throttle valve opening in accordance with the amount of the accelerator pedal effort, and the conditions of the engine and the vehicle, and comprehensively controls the ISC, and cruise control. For details, see page 63.	■	■
Fuel Pump Control	The fuel pump speed is controlled by the fuel pump relay and the fuel pump resistor.	■	■
	A fuel cut control is adopted to stop the fuel pump when the airbag is deployed at the front or side collision. For details, see page 67.	■	—
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	■	■
Air Conditioning Cut-off Control	By controlling the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.	■	■
Evaporative Emission Control	The ECM controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.	■	■
	Using 3 VSVs and a vapor pressure sensor, the ECM detects any evaporative emission leakage occurring between the fuel tank and the charcoal canister through the changes in the tank pressure. For details, see page 68.	■	—
Engine Immobiliser	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.	■	—
Diagnosis	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.	■	■
	<ul style="list-style-type: none"> A DTC (Diagnostic Trouble Code) P0128 has been added for indicating a thermostat malfunction. To increase the speed for processing the signals, the 32-bit CPU of the ECM has been adopted. Accordingly, the length of time to clear the DTC via the battery terminal has been changed from the previous 10 seconds to 1 minute. For details, refer to the 2001 Sequoia Repair Manual (Pub. No. RM832U).	■	—
Fail-safe	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.	■	■

2. Construction

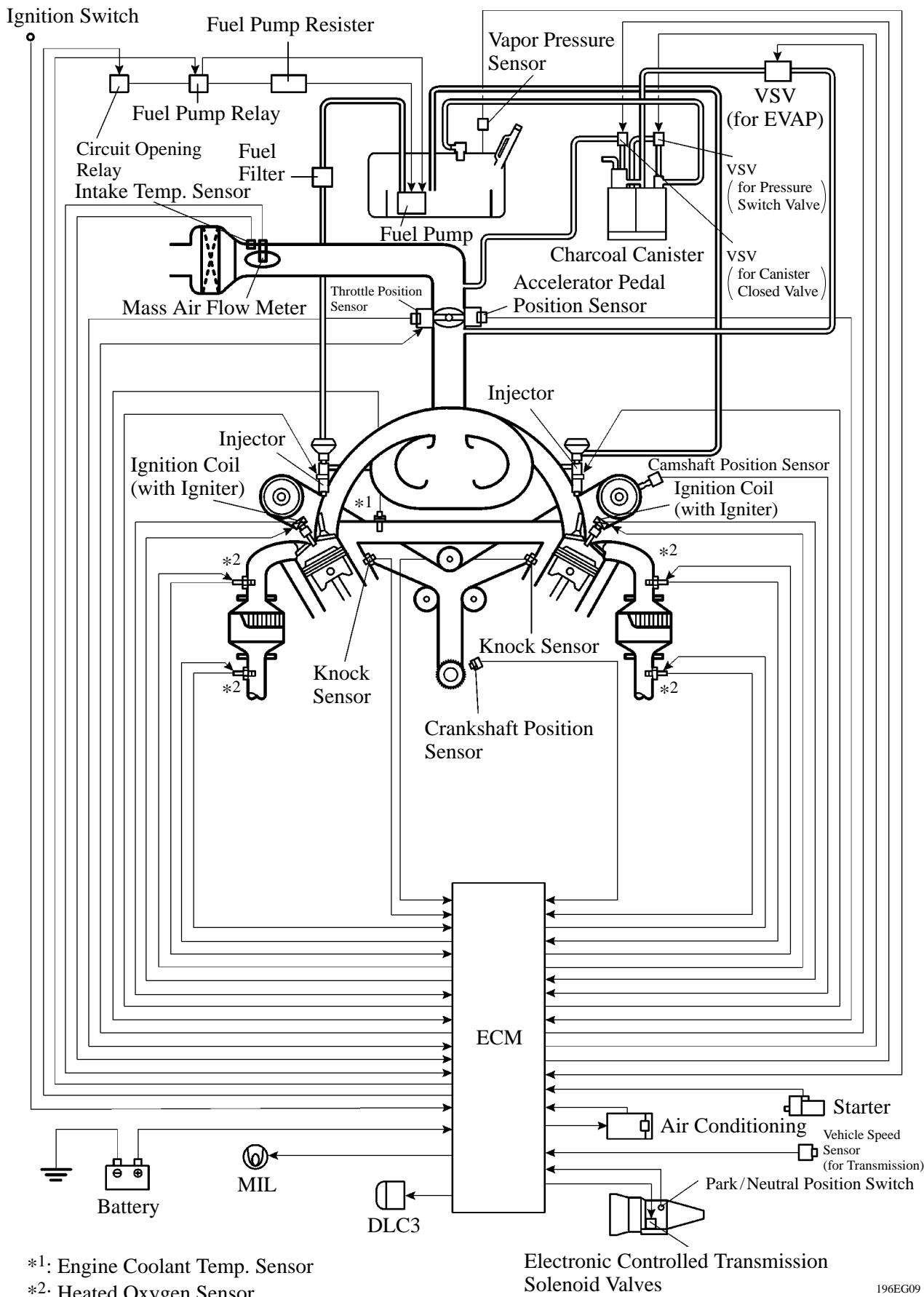
The configuration of the engine control system in the 2UZ-FE engine is shown in the following chart.



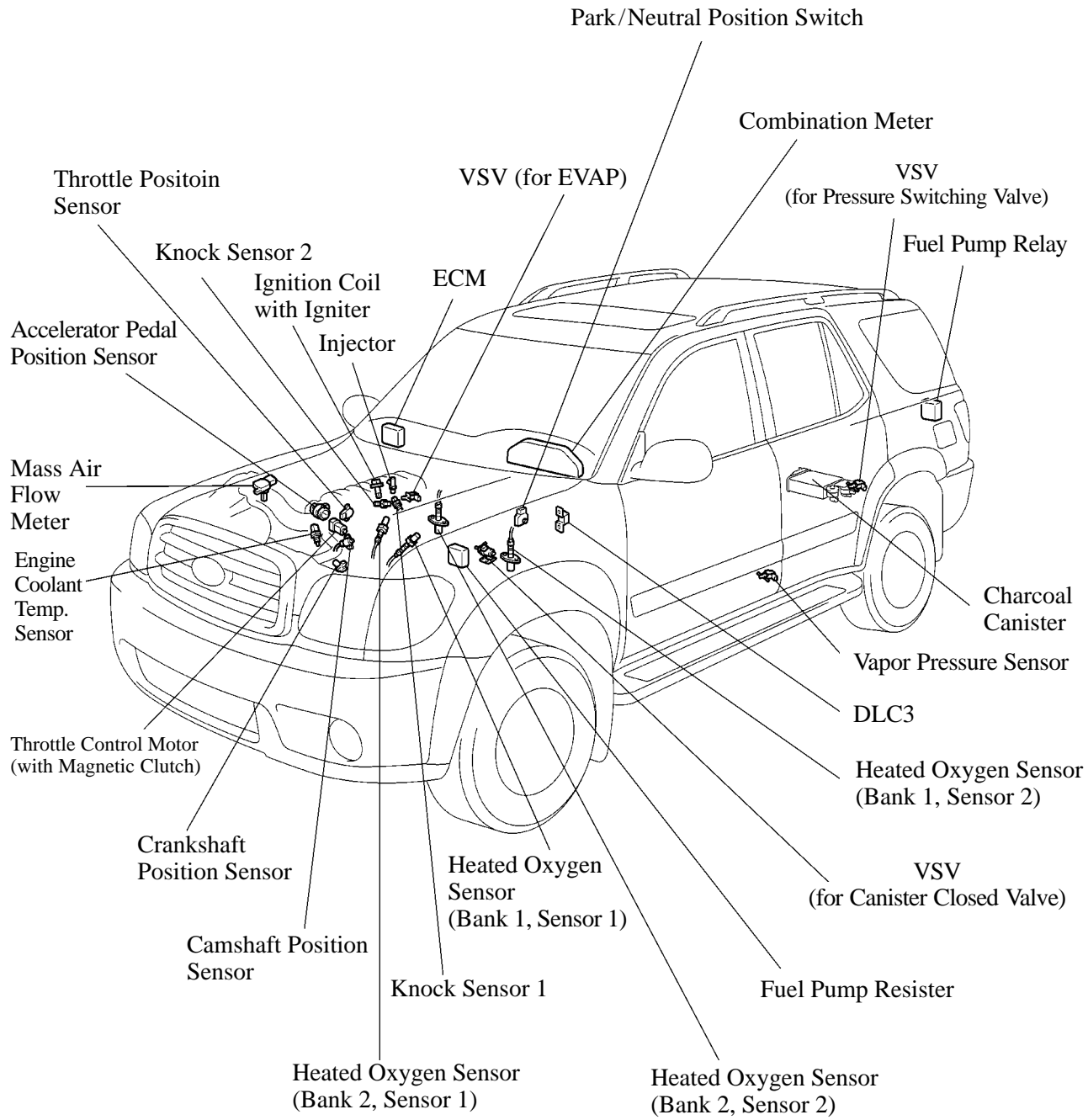
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3. Engine Control System Diagram



4. Layout of Components



5. Main Components of Engine Control System

General

The main components of the 2UZ-FE engine control system are as follows:

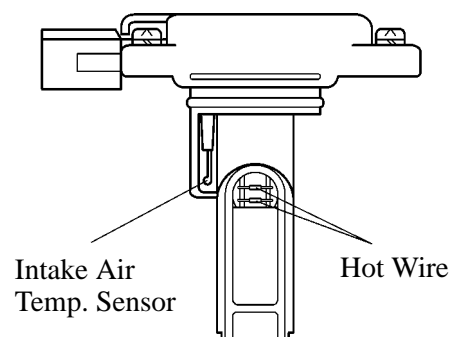
Component	Outline	Quantity
Mass Air Flow Meter	Hot-Wire Type	1
Crankshaft Position Sensor (Rotor Teeth)	Pick-Up Coil Type (36-2)	1
Camshaft Position Sensor (Rotor Teeth)	Pick-Up Coil Type (1)	1
Throttle Position Sensor	Linear Type	2
Accelerator Pedal Position Sensor	Linear Type	2
Knock Sensor	Built-In Piezoelectric Type	2
Oxygen Sensor (Bank 1, Sensor 1) (Bank 1, Sensor 2) (Bank 2, Sensor 1) (Bank 2, Sensor 2)	With Heater Type	4
Injector	4-Hole Type	8

Mass Air Flow Meter

The 2UZ-FE engine adopts the hot-wire type mass air flow meter designed for direct electrical measurement of the intake air mass flow.

This mass air flow meter offers superior measuring precision and its plastic housing is shaped for minimal flow resistance. It has the following features:

- Compact and lightweight
The pressure loss caused by this sensor is small and offers only slight intake air flow resistance.
- Superior response and measuring accuracy.
- Ability to measure a wide airflow range.
- Having no mechanical functions, it offers a superior durability.

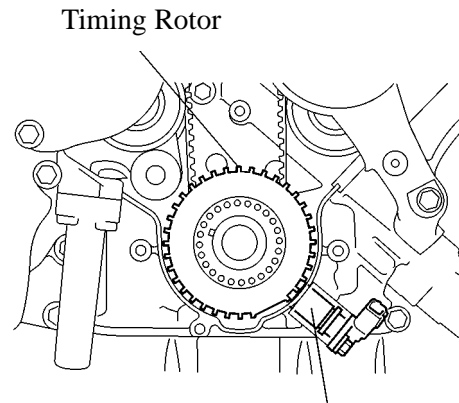


Crankshaft Position Sensor

The crankshaft position sensor is mounted on the oil pump body as illustrated below.

The rotor's teeth are spaced 10° apart, according to crankshaft angle, but since there are 2 teeth missing, as illustrated below, there is a total of 34 teeth.

Accordingly, the ECM can detect the crankshaft angle in addition to the crankshaft speed.

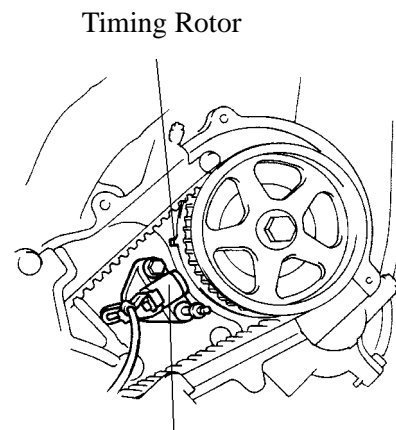


Crankshaft Position Sensor

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Camshaft Position Sensor

The camshaft position sensor is mounted on the left bank cylinder head. To detect the camshaft position, a protrusion that is provided on the timing pulley is used to generate 1 pulse for every 2 revolutions of the crankshaft.



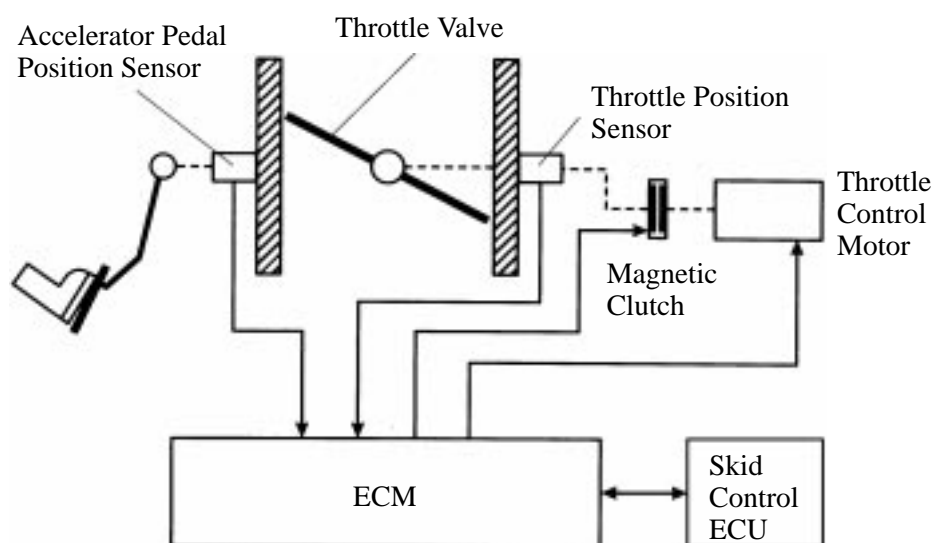
Camshaft Position Sensor

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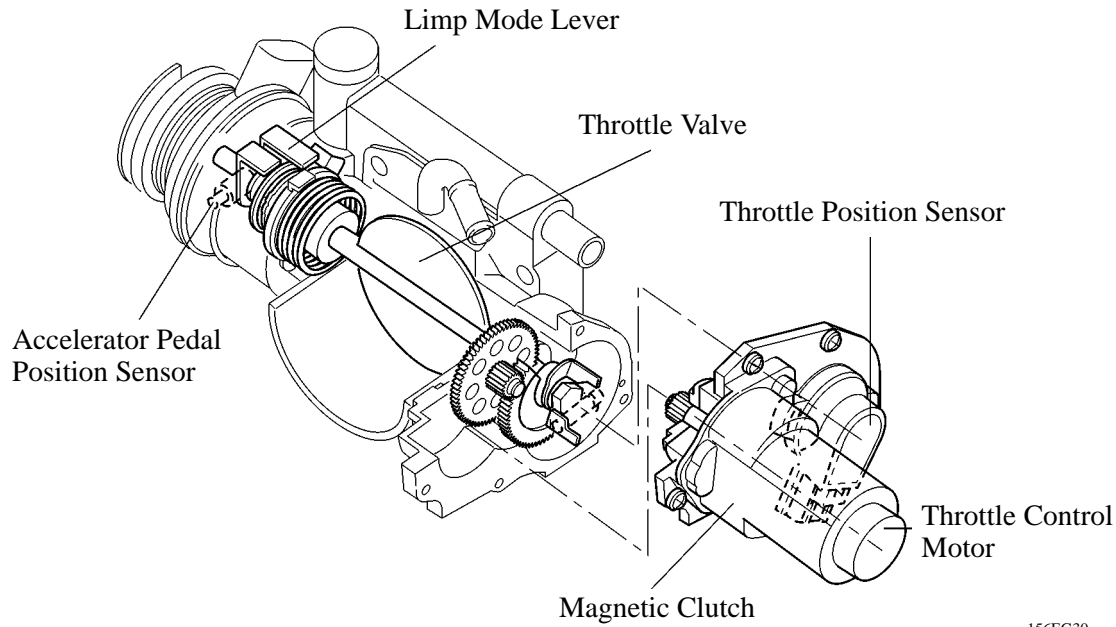
6. ETCS-i (Electronic Throttle Control System-intelligent)

General

- The ETCS-i, which realizes excellent throttle control in all the operating ranges, has been adopted.
- In the conventional throttle body, the throttle valve opening is determined invariably by the amount of the accelerator pedal effort. In contrast, the ETCS-i uses the ECM to calculate the optimal throttle valve opening that is appropriate for the respective driving condition and uses a throttle control motor to control the opening.
- The ETCS-i controls the ISC (Idle Speed Control) system, the cruise control system, the TRAC (Traction Control), and the VSC (Vehicle Skid Control) system.
- A duplicate system is provided to ensure a high level of reliability, and the system shuts off in case of an abnormal condition. Even when the system is shut off, the accelerator pedal can be used to operate the vehicle in the limp mode.



Construction

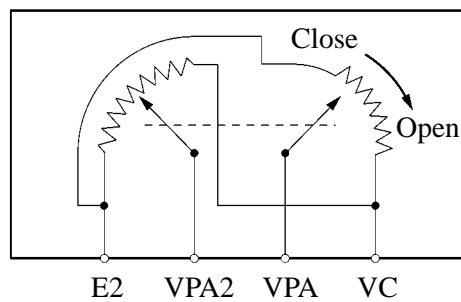


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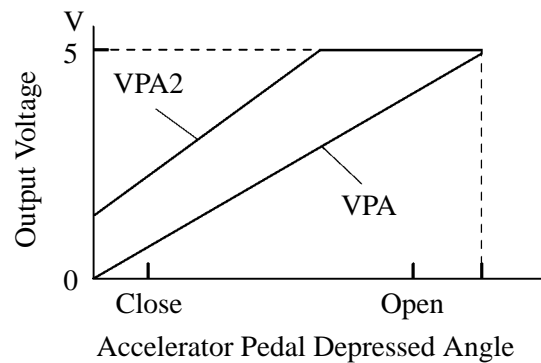
1) Accelerator Pedal Position Sensor

The accelerator pedal position sensor, which is mounted on the throttle body, is integrated with the throttle lever, which is connected to the cable that extends from the accelerator pedal.

The accelerator pedal position sensor converts the amount of accelerator pedal effort into two types of electrical signals with distinct output characteristics. The signals are then input into the ECM.



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2) Throttle Position Sensor

The throttle position sensor converts the throttle valve opening into an electrical signal and inputs into the ECM. The output characteristics are the same as those of the accelerator position pedal sensor.

3) Throttle Control Motor

A DC motor with excellent response and minimal power consumption is used for the throttle control motor. The ECM performs the duty ratio control of the direction and the amperage of the current that flows to the throttle control motor in order to regulate the opening of the throttle valve.

4) Magnetic Crutch

Ordinarily, the magnetic clutch engages the clutch to enable the throttle control motor to open and close the throttle valve. In case that a malfunction occurs in the system, this clutch is disengaged to prevent the throttle control motor to open and close the throttle valve.

Operation

1) General

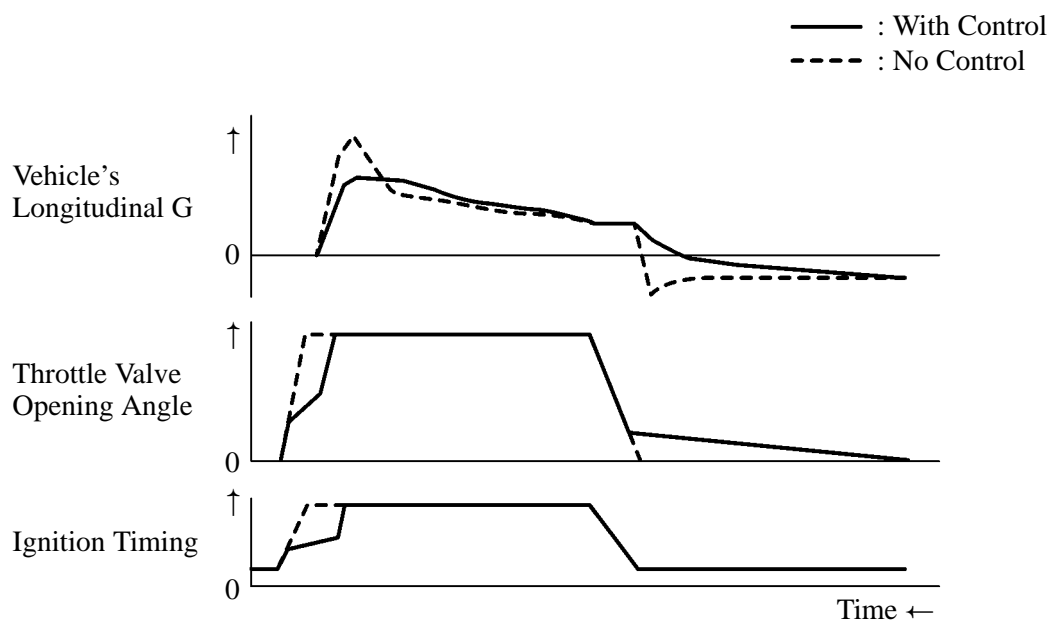
The ECM drives the throttle control motor by determining the target throttle valve opening in accordance with the respective operating condition.

- 1) Non-Linear Control
- 2) Idle Speed Control
- 3) TRAC Throttle Control
- 4) VSC Coordination Control
- 5) Cruise Control

2) Non-Linear Control

Controls the throttle to an optimal throttle valve opening that is appropriate for the driving condition such as the amount of the accelerator pedal effort and the engine speed in order to realize excellent throttle control and comfort in all operating ranges.

• Control Examples During Acceleration and Deceleration ◀



150EG37

3) Idle Speed Control

Previously, a step motor type IAC valve was used to perform idle speed control such as fast idle during cold operating conditions and idle-up. In conjunction with the adoption of the ETCS-i, controls the ECM and the throttle valve in order to constantly effect ideal idle speed control.

4) TRAC Throttle Control

As part of the TRAC system, the throttle valve is closed by a demand signal from the skid control ECU if an excessive amount of slippage is created at a driving wheel, thus facilitating the vehicle in ensuring stability and driving force.

5) VSC Coordination Control

In order to bring the effectiveness of the VSC system control into full play, the throttle valve opening angle is controlled by effecting a coordination control with the skid control ECU.

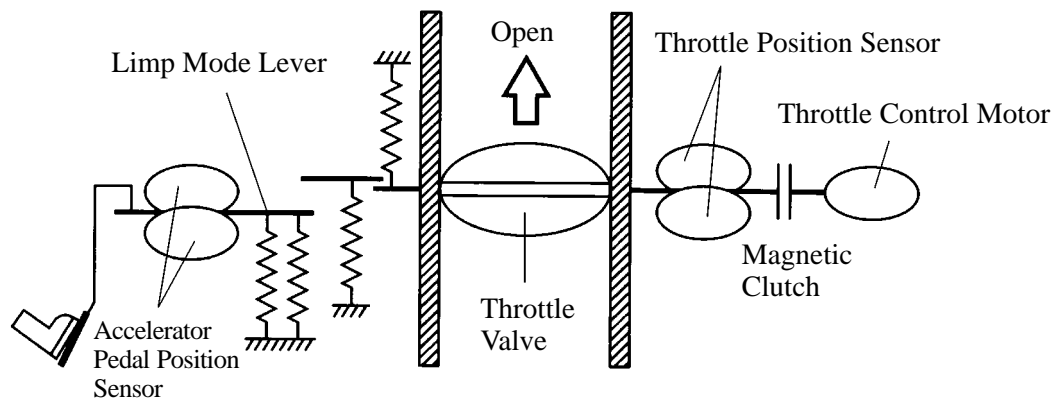
6) Cruise Control

Previously the vehicle speed was controlled by the cruise control ECU, which open and closed the throttle valve. In conjunction with the adoption of the ETCS-i, an ECM with an integrated cruise control ECU directly actuates the throttle valve to effect the operation.

Fail-Safe

If an abnormal condition occurs with the ETCS-i, the MIL illuminates to alert the driver. At the same time, the current to the throttle control motor and magnetic clutch are cut off in order not to operate the ETCS-i. This enables the return spring to close the throttle valve.

Even in this situation, the accelerator pedal can be used to operate the limp mode lever, which operates the throttle valve to enable the vehicle to be driven in the limp mode.



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Diagnosis

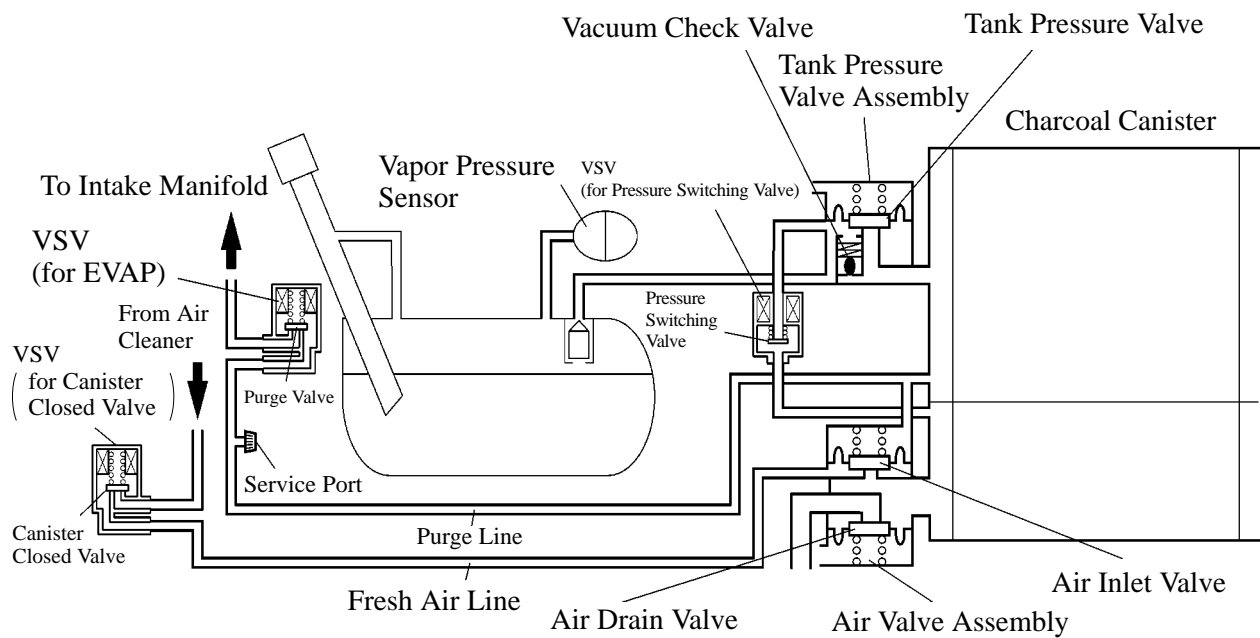
The diagnostic trouble codes can be output via DLC3 to an OBD-II scan tool or a hand-held tester. For details, refer to the 2001 Sequoia Repair Manual (Pub. No. RM832U).

8. Evaporative Emission Control System

General

The vacuum type has been adopted to detect leaks in the evaporative emission control system. This vacuum type detects leaks by forcefully introducing the purge vacuum into the entire system and monitoring the changes in the pressure. It consists of the following main components:

- A VSV (for canister closed valve) that closes the fresh air line from the air cleaner to the charcoal canister has been adopted.
- A VSV (for pressure switching valve) that opens the evaporator line between the fuel tank and the charcoal canister has been adopted.
- Function to close the purge line from the air intake chamber to the charcoal canister for this system is added to the original functions of VSV (for EVAP).
- A vapor pressure sensor that measures the pressure in the fuel tank while checking for evaporative emission leaks and sends signals to the ECM has been adopted.

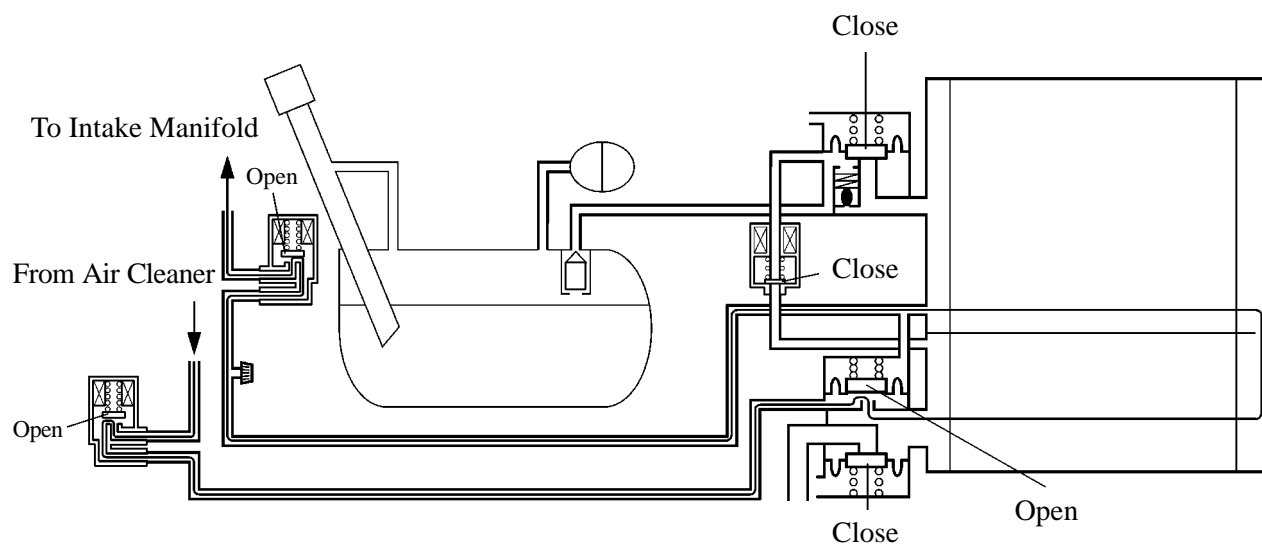


Operation

1) Purge Flow

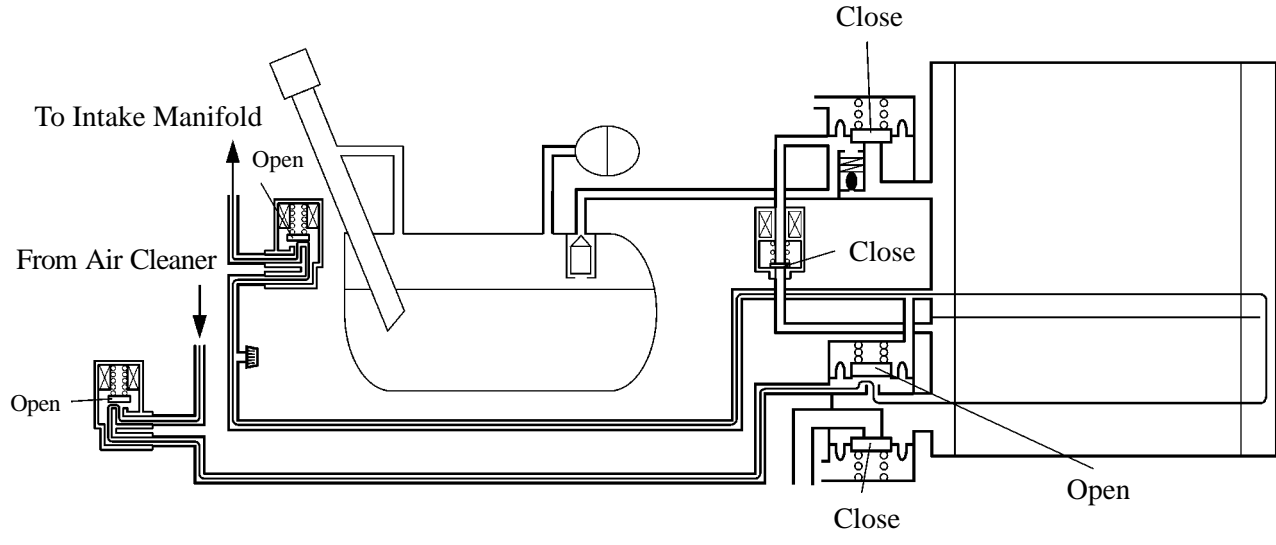
When the engine has reached predetermined parameters (closed loop, engine coolant temp. above 74°C (165°F), etc.) stored fuel vapors are purged from the charcoal canister whenever the purge valve is opened by the ECM. At the appropriate time, the ECM will turn on the VSV (for EVAP).

The ECM will change the duty ratio cycle of the VSV (for EVAP) thus controlling purge flow volume. Purge flow volume is determined by intake manifold pressure and the duty ratio cycle of the VSV (for EVAP). Atmospheric pressure is allowed into the charcoal canister to ensure that purge flow is constantly maintained whenever purge vacuum is applied to the charcoal canister.

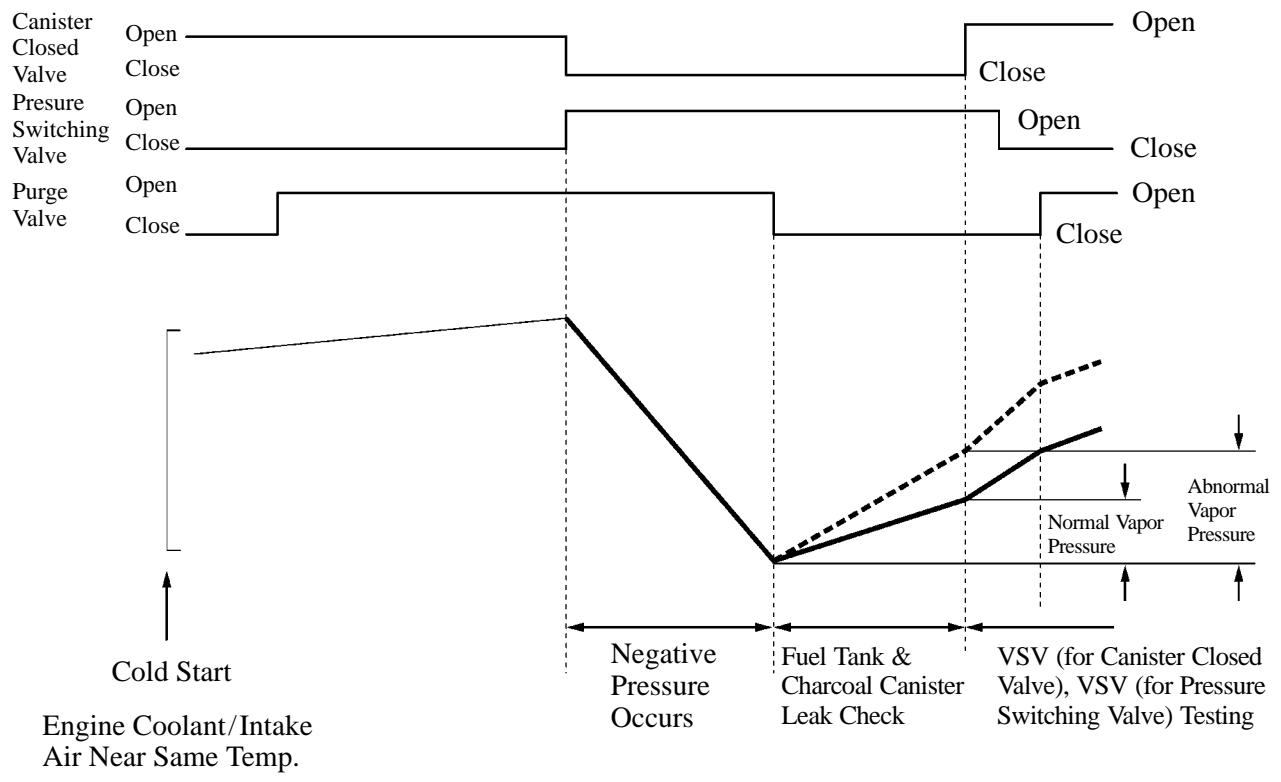


2) Monitor

The monitor sequence begins with a cold engine start. The intake air temp. and engine coolant temp. sensors must have approximately the same temperature reading. The ECM is constantly monitoring fuel tank pressure. As the temperature of the fuel increases, pressure slowly rises. The ECM will purge the charcoal canister at the appropriate time. With pressure switching valve closed, pressure will continue to rise in fuel tank.



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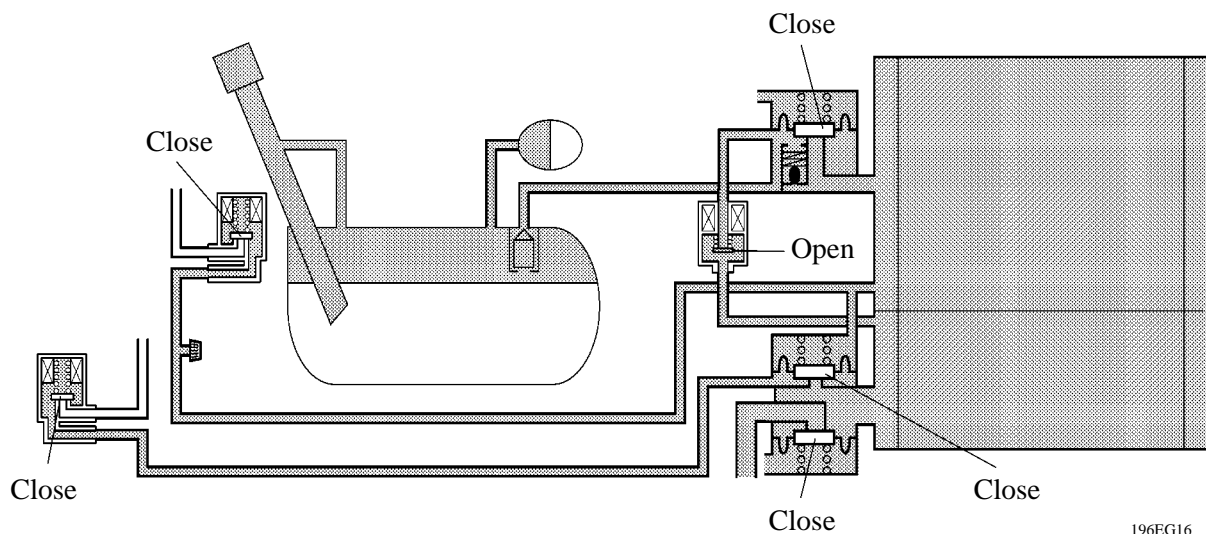
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3) DTC P0440 (Evaporative Emission Control System Malfunction)

Initially when the canister closed valve is closed, and the pressure switching valve and the purge valve are opened, a vacuum is applied to the purge line from the air intake to the charcoal canister and to the evaporator line from the charcoal canister to the fuel tank. Next, the purge valve is closed in order to maintain a vacuum from the VSV (for EVAP) to the inside of the fuel tank. Then, any subsequent changes in the pressure are monitored by the vapor pressure sensor in order to check for evaporative emission leaks.

If a leak is detected, the MIL (Malfunction Indicator Lamp) illuminates to inform the driver. Also, the DTC (Diagnostic Trouble Code) can be accessed through the use of a hand-held tester.

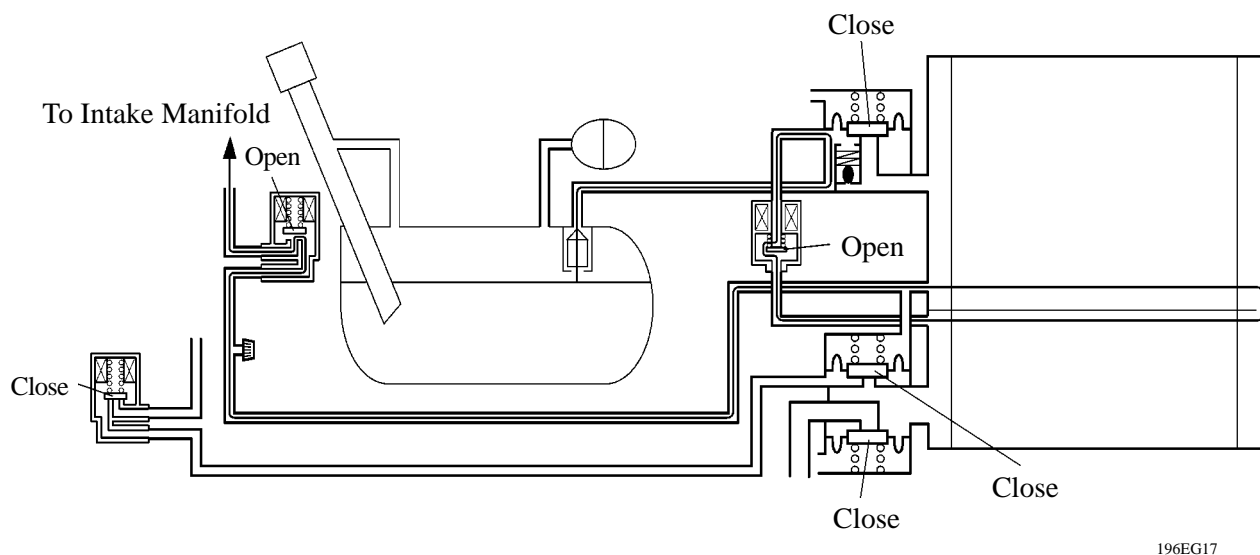
For details on the DTCs, refer to the 2001 Sequoia Repair Manual (Pub. No. RM832U).



4) DTC P0441 (Evaporative Emission Control System Incorrect Purge Flow)

At a predetermined point, the ECM closed the canister closed valve and opens the pressure switching valve causing a pressure drop in the entire EVAP system. The ECM continues to operate the VSV (for EVAP) until the pressure is lowered to a specified point at which time the ECM closed the purge valve. If the pressure did not drop, or if the drop in pressure increased beyond the specified limit, the ECM judges the VSV (for EVAP) and related components to be faulty and MIL illuminates to inform the driver. Also, the DTC can be accessed through the use of a hand-held tester.

For details on the DTCs, refer to the 2001 Sequoia Repair Manual (Pub. No. RM832U).

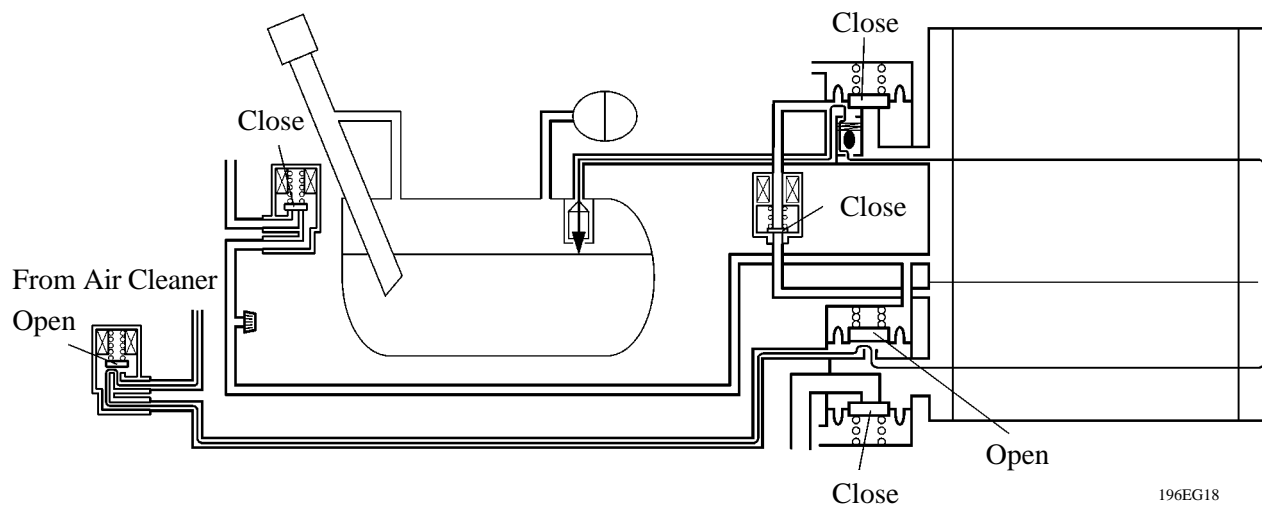


5) DTC P0446 (Evaporative Emission Control System Vent Control Malfunction)

a. Canister Closed Valve

This stage checks the VSV (for canister closed valve) and vent (air inlet side) operation. When the vapor pressure rises to a specified point, the ECM opens the canister closed valve. Pressure will increase rapidly because of the air allowed into the system. No increase or an increase below specified rate of pressure increase indicates a restriction on the air inlet side. If a malfunction is detected, the MIL illuminates to inform the driver. Also, the DTC can be accessed through the use of a hand-held tester.

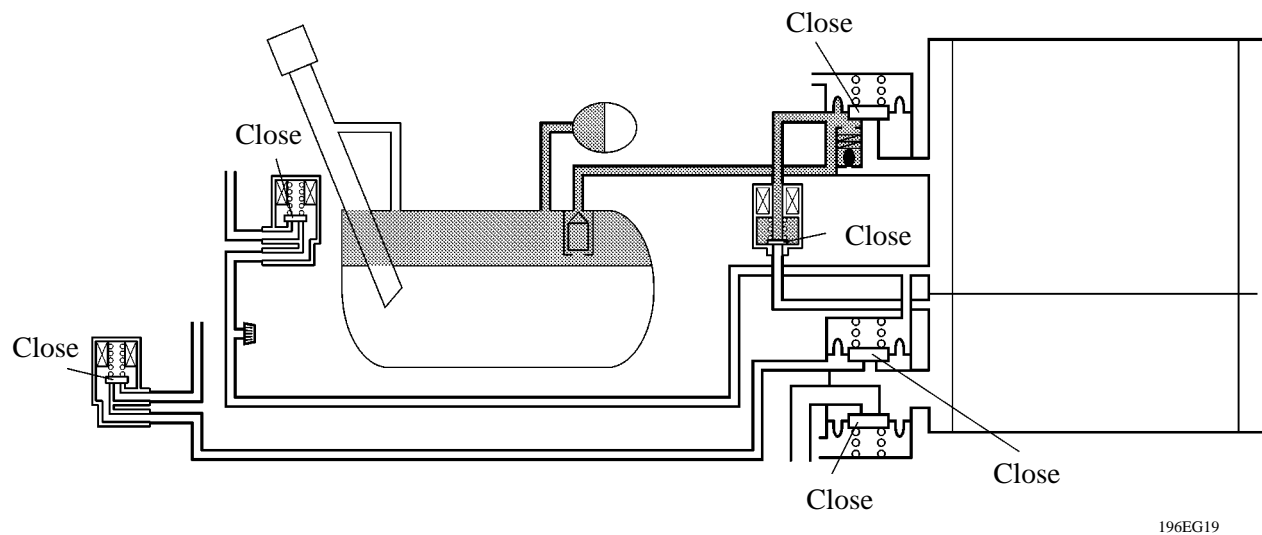
For details on the DTCs, refer to the 2001 Sequoia Repair Manual (Pub. No. RM832U).



b. Pressure Switching Valve

The ECM closes the pressure switching valve. This action blocks air entering the tank side of the system. The pressure rise is no longer as great. If there was no change in pressure, the ECM will conclude the pressure switching valve did not close. If a malfunction is detected, the MIL illuminates to inform the driver. Also, the DTC can be accessed through the use of a hand-held tester.

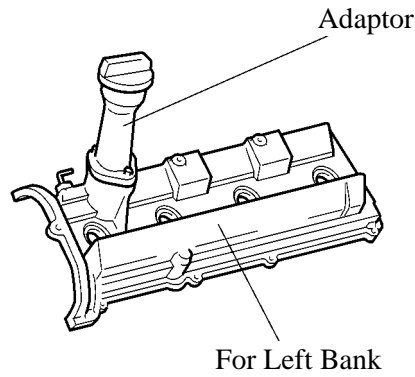
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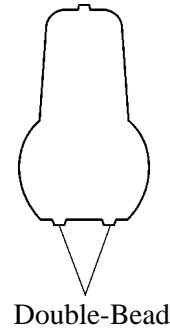
◀ENGINE PROPER

1. Cylinder Head Cover

- Lightweight yet high-strength aluminum head covers are used.
- An adaptor has been provided on the left bank cylinder head cover to improve the serviceability when filling the engine oil.
- The cylinder head cover gaskets have adopted a double-bead cross-sectional construction to improve their reliability.



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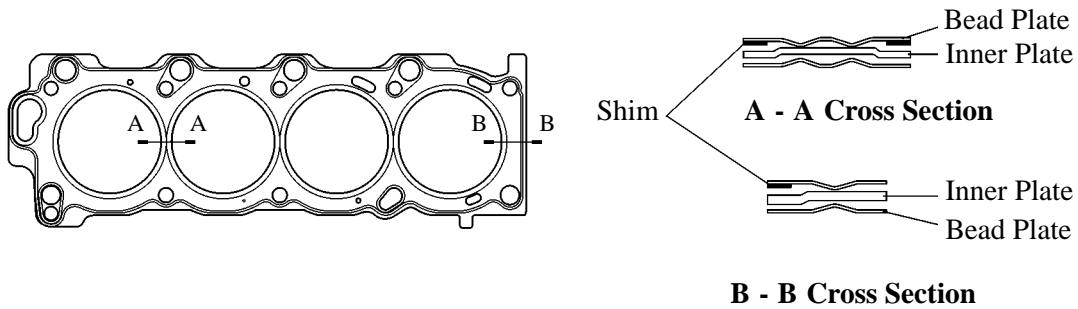


**Cylinder Head Cover
Gasket Cross Section**

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2. Cylinder Head Gasket

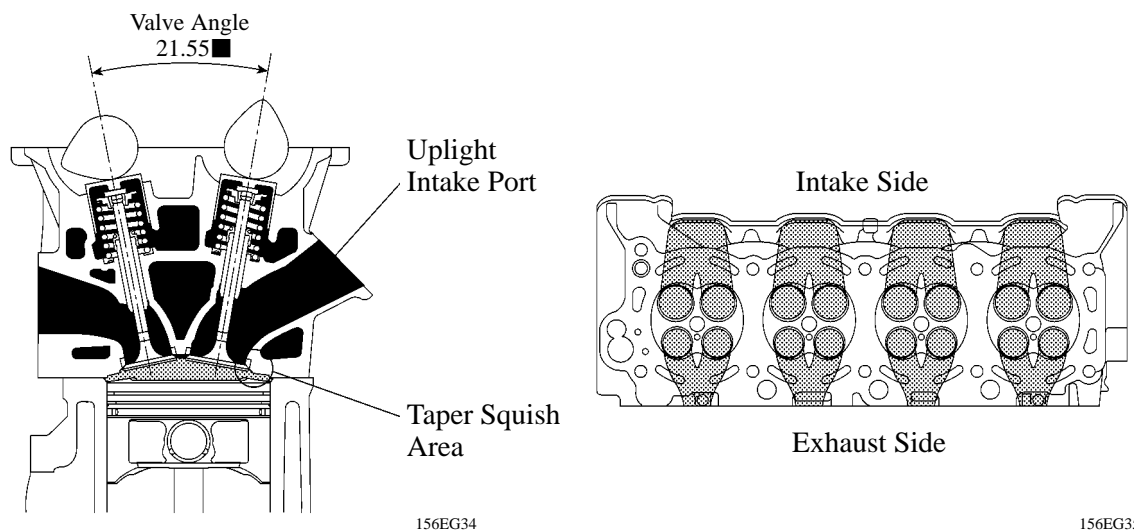
3-layer cylinder head gaskets with shims have been adopted to ensure reliability and to minimize the deformation of the cylinder bore. This resulted in improved fuel economy and reduced the consumption rate of engine oil and the emission of exhaust gases.



156EG33

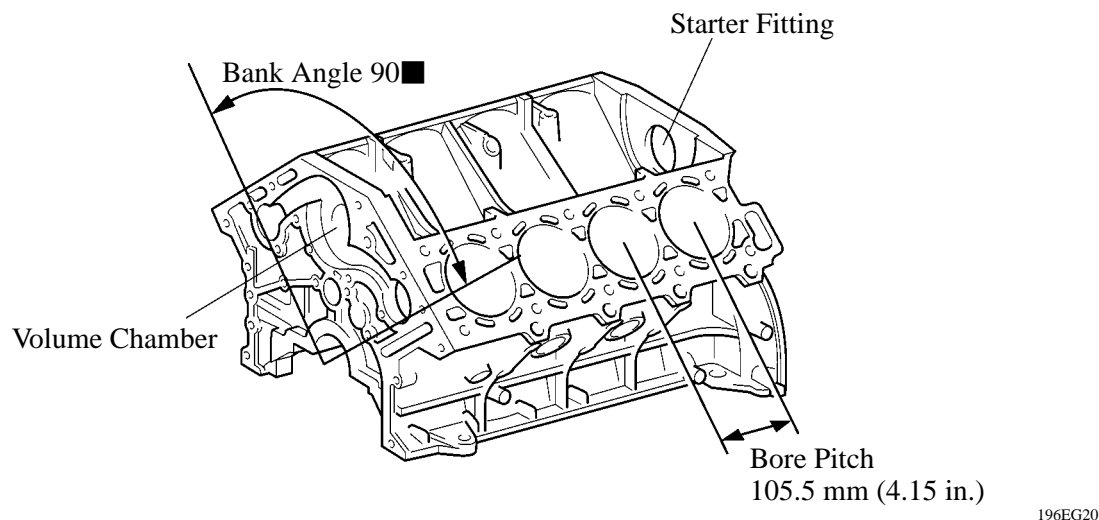
3. Cylinder Head

- The cylinder head, which is made of aluminum, has adopted a pentroof-type combustion chamber. The spark plug has been located in the center of the combustion chamber in order to improve the engine's anti-knocking performance.
- The angle of the intake and exhaust valves is narrowed and set at 21.55° to permit a compact cylinder head.
- Upright intake ports have been adopted to improve the intake efficiency.
- A taper squish combustion chamber has been adopted to improve anti-knocking performance and intake efficiency. In addition, engine performance and fuel economy have been improved.
- Plastic region tightening bolt is used for the cylinder head bolts for good axial tension.



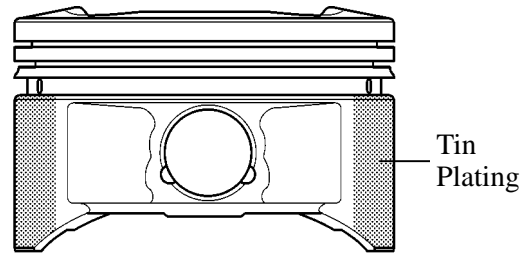
4. Cylinder Block

- The cylinder block is made of cast iron.
- The cylinder block has a bank angle of 90° a bank offset of 21 mm (0.827 in.) and a bore pitch of 105.5 mm (4.15 in.), resulting in a compact block in its length and width even for its displacement.
- Part of the volute chamber of the water pump is incorporated into the cylinder block to shorten the engine length.
- Installation bosses of the two knock sensors are located on the inner side of left and right banks.
- The plastic region tightening bolts are used, for the crankshaft bearing caps.
- The starter is located inside the V-bank.



5. Piston

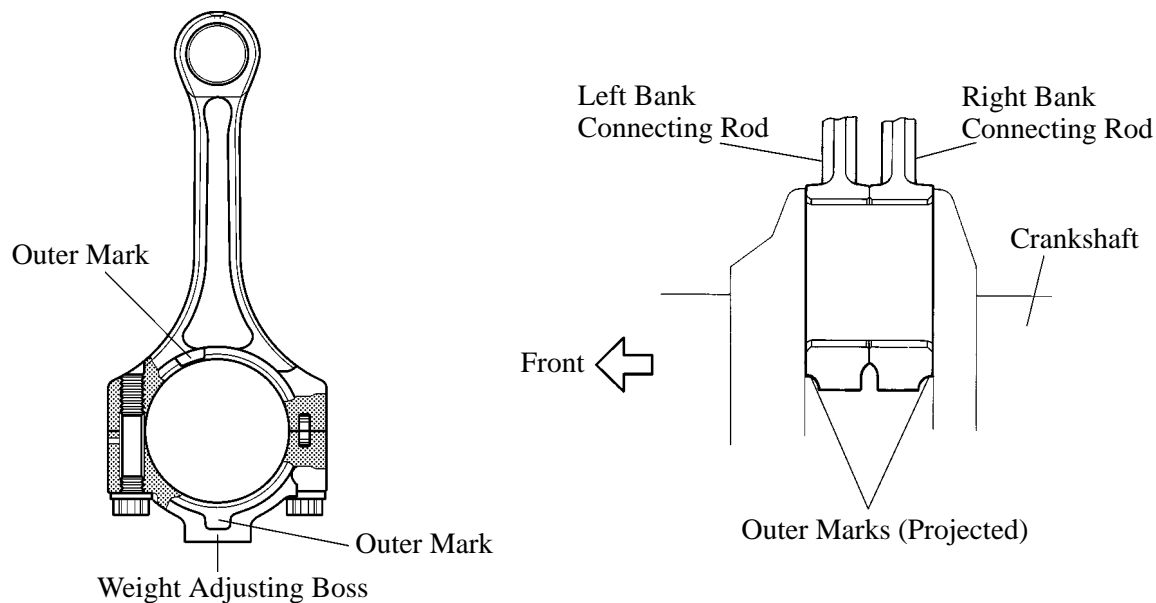
- The piston is made of aluminum alloy.
- The piston head portion has adopted a taper squish to improve the fuel combustion efficiency.
- The piston ring grooves have been treated with alumite coating to improve the piston's wear resistance.
- Full floating type piston pins are used.
- The skirt portion of the piston has been applied with tin plating to reduce friction.



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6. Connecting Rod

- The sintered and forged connecting rod is very rigid and has little weight fluctuation.
- A weight-adjusting boss is provided at the big end to reduce fluctuation of weight and balance the engine assembly.
- The connecting rod cap is held by plastic region tightening bolts.
- The connecting rods for the right and left banks are placed in opposite directions with the outer marks facing the crankshaft.
- The connecting rod bearing is made of aluminum alloy.

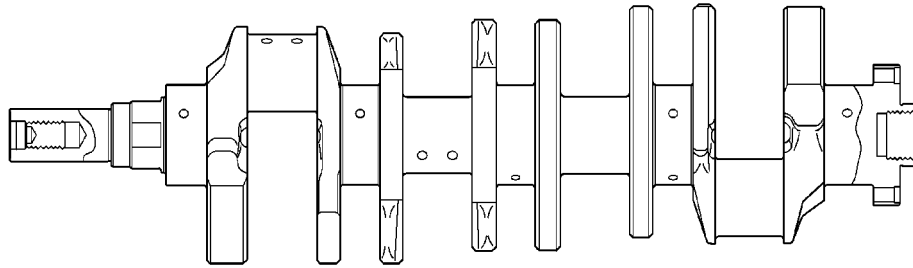


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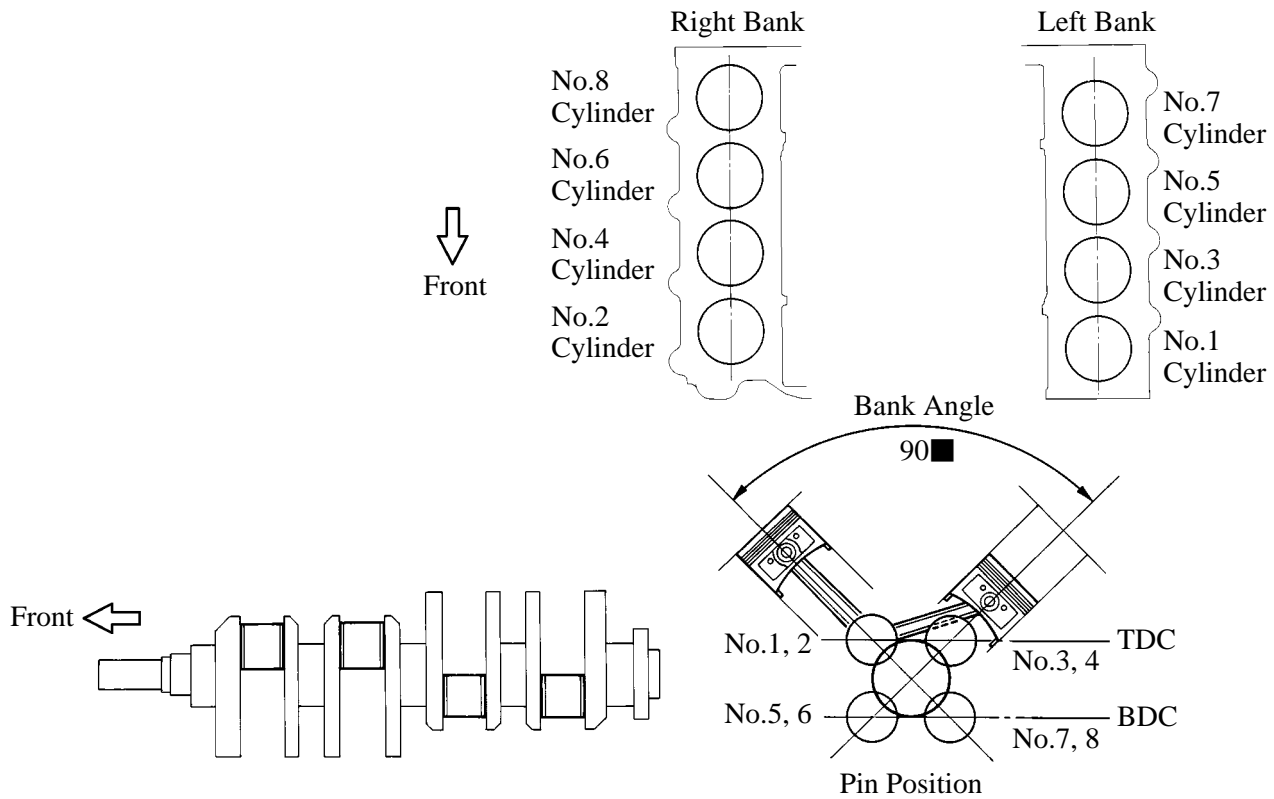
7. Crankshaft

- A crankshaft made of steel, which excels, in rigidity and wear resistance, has been adopted.
- The crankshaft has 5 journals and 8 counter weights.
- The crankshaft bearing is made of aluminum alloy.



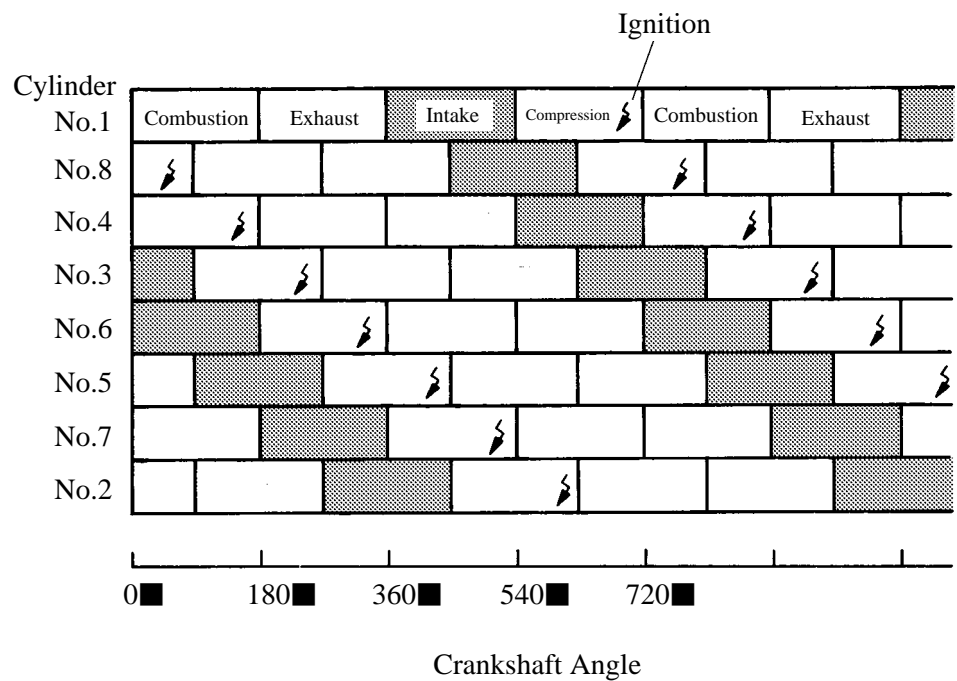
156EG25

NOTE: The positions of the crankshaft pins and pistons are illustrated below. The numbers of the crankshaft and the pistons are shown on the right.



156EG10

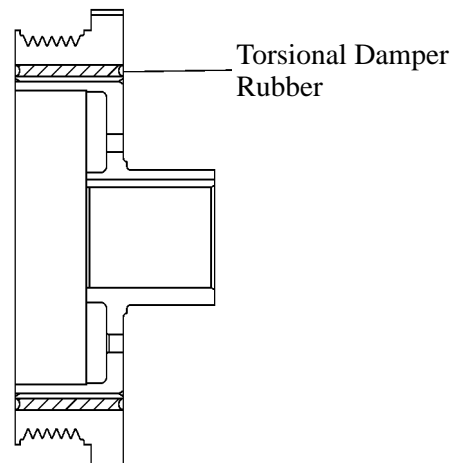
- Crankshaft angles and engine strokes (intake, compression, combustion and exhaust) are shown in the table below. The firing order is 1 - 8 - 4 - 3 - 6 - 5 - 7 - 2.



156EG11

8. Crankshaft Pulley

The rigidity of the torsional damper rubber has been optimized to reduce noise.

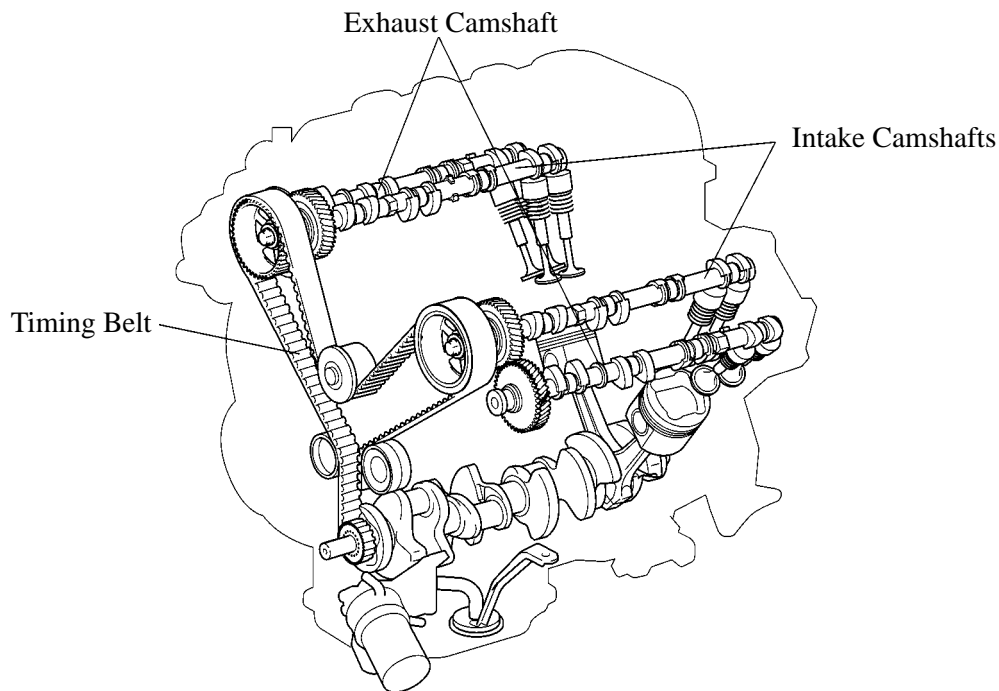


156EG37

◀ VALVE MECHANISM

1. General

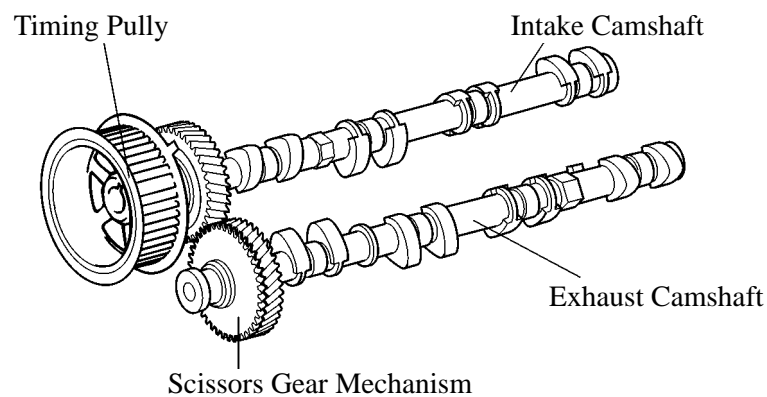
- Each cylinder has 2 intake valves and 2 exhaust valves. Intake and exhaust efficiency is increased by means of the larger total port areas.
- The valves are directly opened and closed by 4 camshafts.
- The intake camshafts are driven by a timing belt, while the exhaust camshafts are driven through gears on the intake camshafts.



196EG02

2. Camshaft

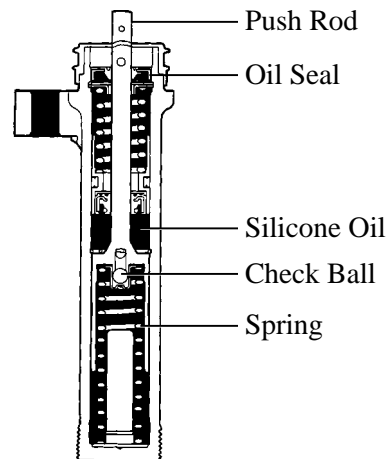
- The camshafts are made of cast iron alloy. The cam nose has been chill treated to increase its abrasion resistance.
- The exhaust camshafts are driven by gears on the intake camshafts. The scissors gear mechanism is used on the exhaust camshaft to control backlash and suppress gear noise.



156EG39

3. Automatic Tensioner

The automatic tensioner is made up of a spring and oil damper, and maintains proper timing belt tension at all time. The automatic tensioner suppresses noise generated by the timing belt.

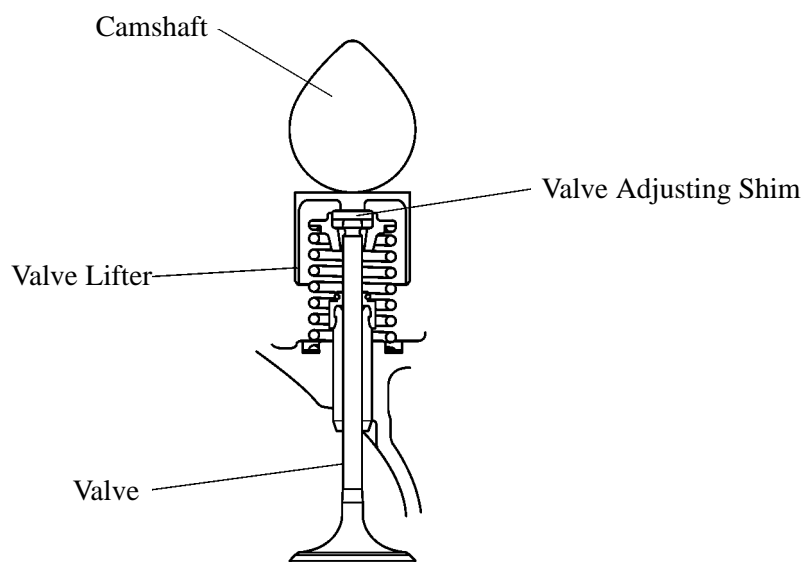


Automatic Tensioner

156EG12

4. Intake and Exhaust Valve and Valve Lifter

- Intake and exhaust valves with large-diameter valve face have been adopted to improve the intake and exhaust efficiency. In addition, narrower valve stems have been adopted to reduce the intake and exhaust resistance and for weight reduction.
- Inner shim type valve adjusting shims, which allow a greater amount of valve lift, have been adopted.
- Valve lifters made of steel have been adopted.

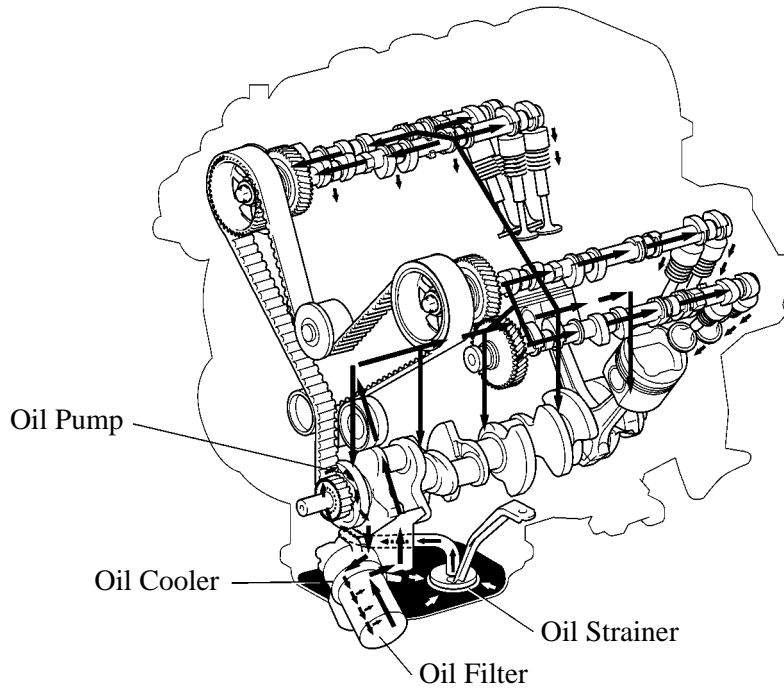


196EG24

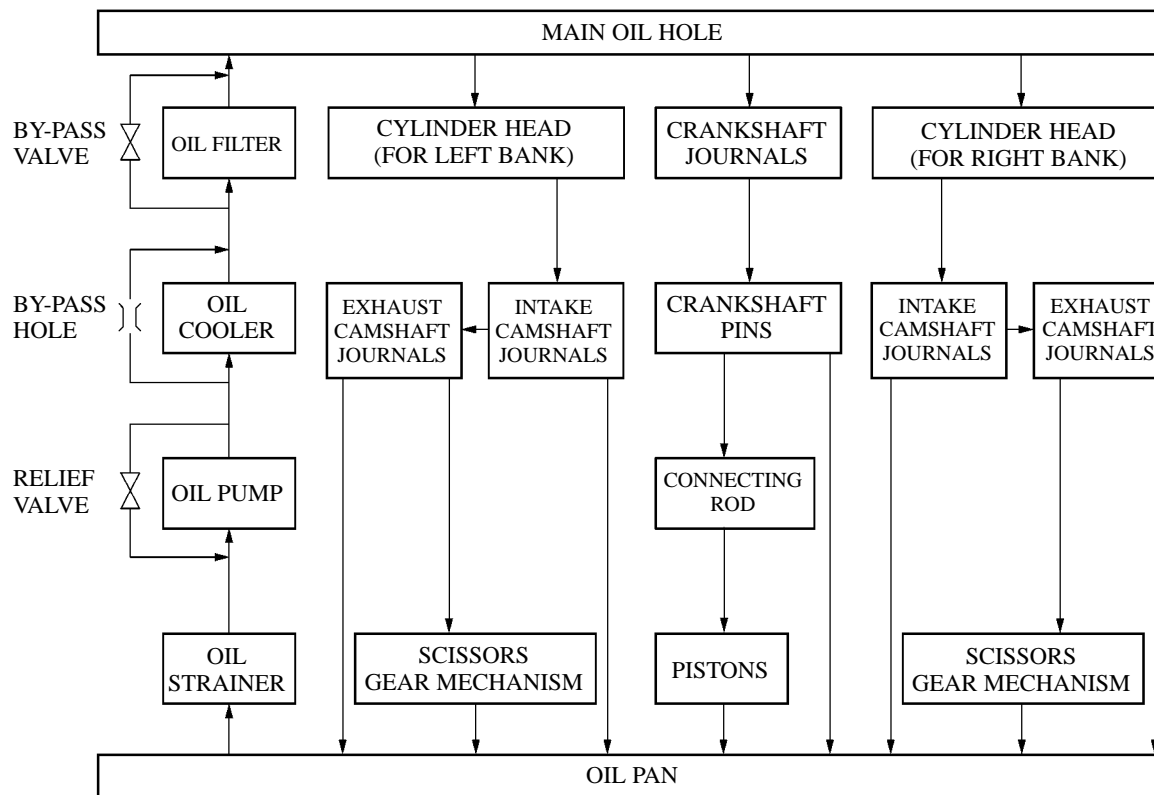
◀ LUBRICATION SYSTEM

1. General

- The lubrication circuit is fully pressurized and all oil passes through an oil filter.
- A trochid gear type oil pump is directly driven by crankshaft.
- The water-cooled type engine oil cooler is used to lower the oil temperature.



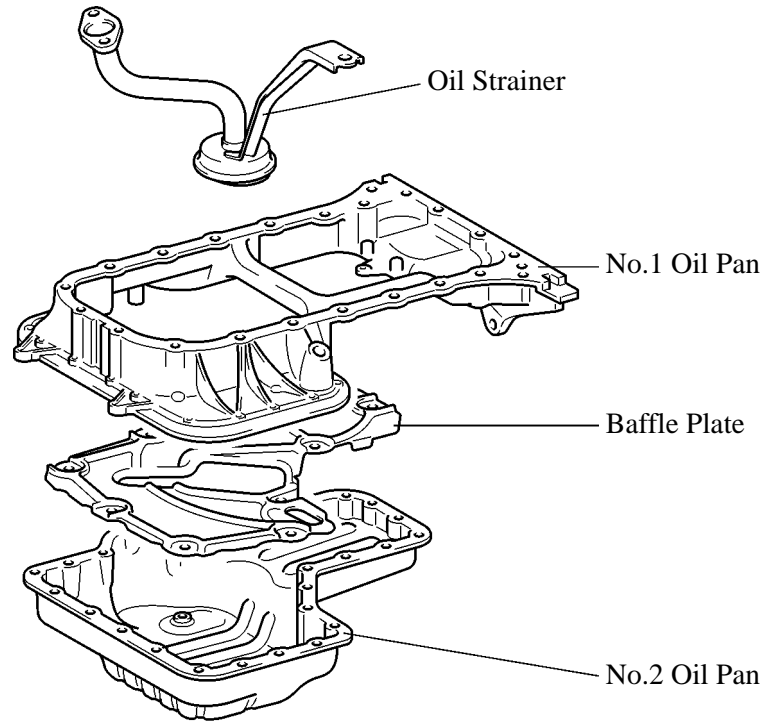
196EG03



196EG04

2. Oil Pan

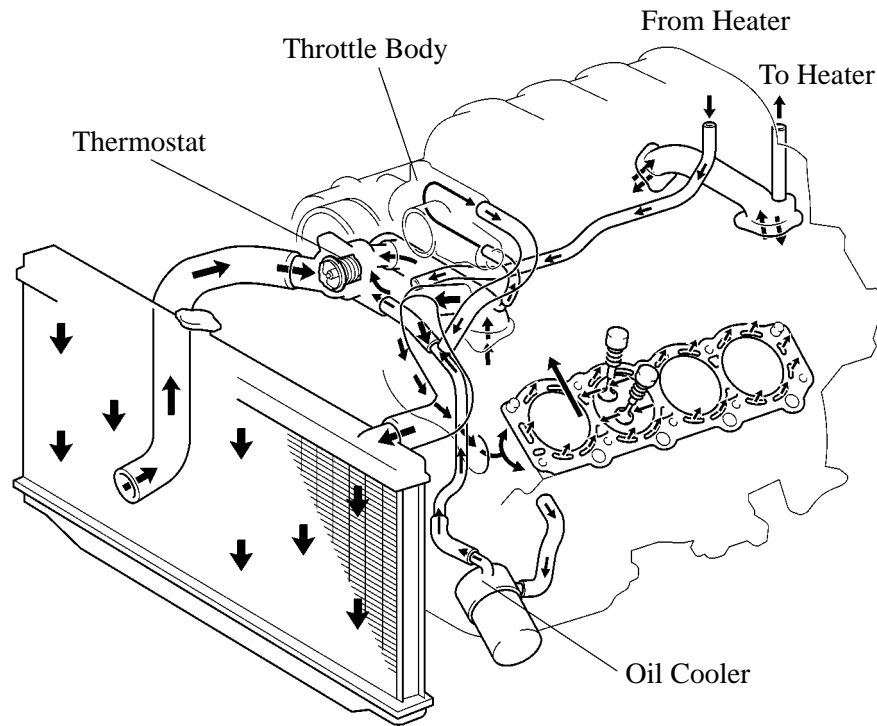
- The oil pan is made up of 2 pieces. No.1 oil pan is made of aluminum alloy and No.2 oil pan is made of steel sheet.
- No.1 oil pan is secured to the cylinder block and the torque converter housing and is increasing rigidity.



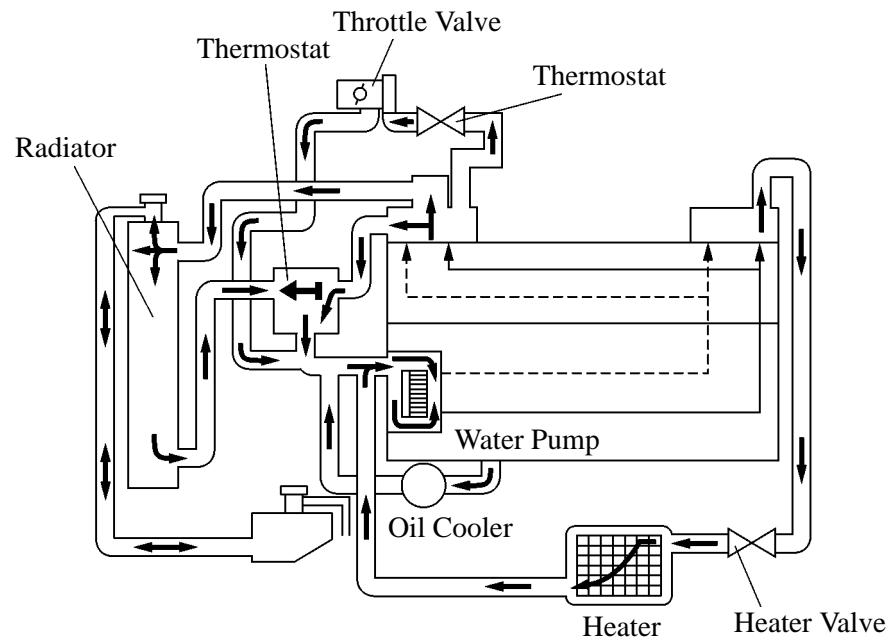
◀ COOLING SYSTEM

1. General

- The cooling system is a pressurized, forced-circulation type.
- A thermostat with a bypass valve is located on the water inlet housing to maintain suitable temperature distribution in the cooling system.
- An aluminum radiator core is used for weight reduction.
- The automatic transmission oil cooler has been adopted to the multi-plate aluminum type.



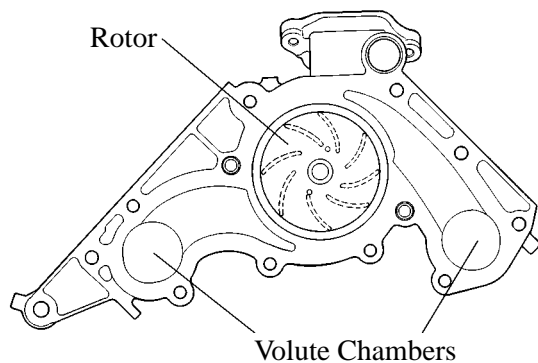
196EG06



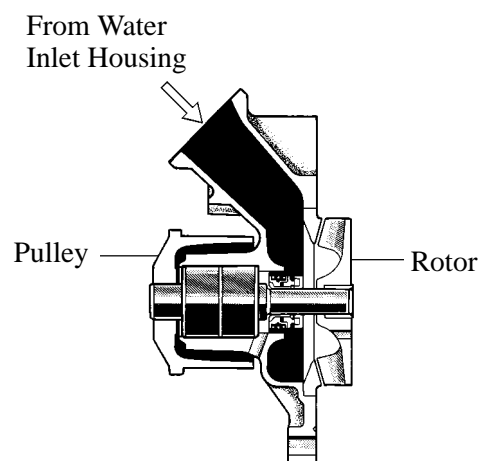
156EG43

2. Water Pump

- The water pump has two volute chambers, and circulates coolant uniformly to the left and right banks of the cylinder block.
- The water pump is driven by the back of the timing belt.
- The rotor is made of resin.



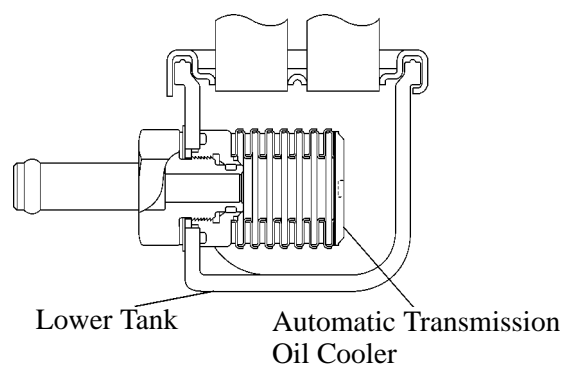
156EG13



156EG14

3. Radiator

- An aluminum radiator core is used for weight reduction.
- The automatic transmission oil cooler has been adopted to the multi-plate aluminum type.



164EG16

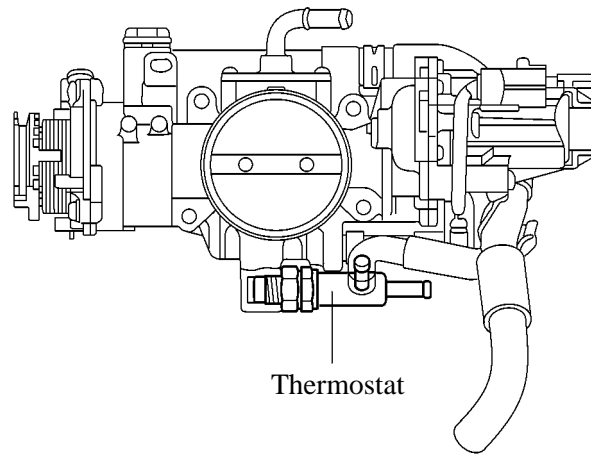
4. Coupling Fan

A 2-stage temperature-controlled coupling fan is used. It rotates at lower speeds when the engine is started to minimize the fan noise.

◀ INTAKE AND EXHAUST SYSTEM

1. Throttle Body

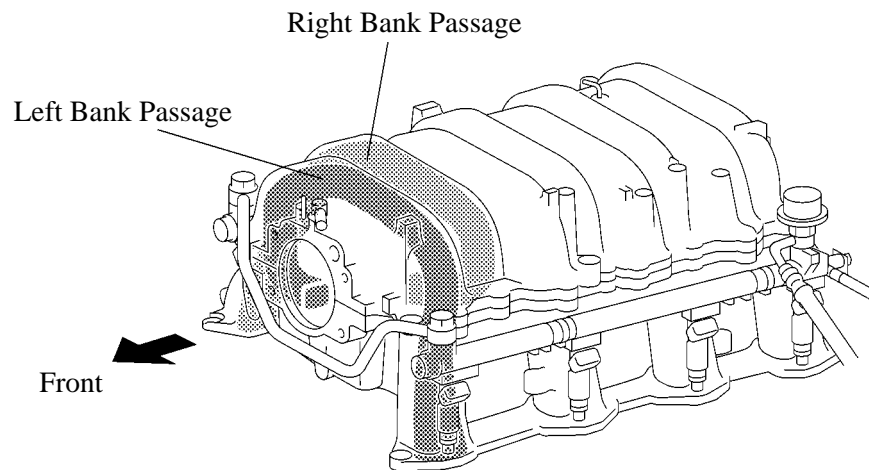
- The adoption of the ETCS-i has realized excellent throttle control.
- The ISC system and cruise control system are controlled comprehensively by the ETCS-i. Thus, the IAC valve has been discontinued.
- A thermostat is installed in the throttle body. The thermostat uses the thermal expansion of the wax to open and close the valve to shut off the flow of warm coolant when the coolant temperature is high in the throttle body's warm coolant passage. This prevents the throttle body temperature from rising more than the needed level, thus restraining the rise in the intake air temperature.



196EG25

2. Intake Manifold

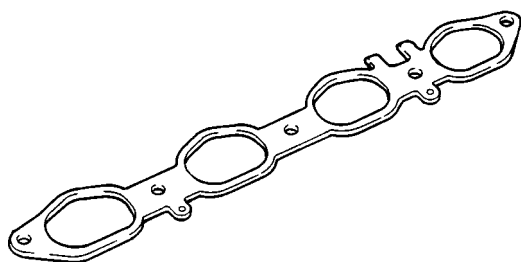
The low-to mid-speed range torque has been improved by increasing the length of the intake manifold port.



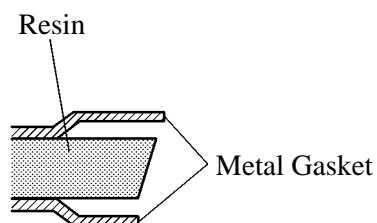
156EG44

3. Intake Manifold Gasket

- A heat-barrier gasket has been adopted for use between the cylinder head and the intake manifold. This gasket, which restrains the heat transfer from the cylinder head to the intake manifold, helps restrain the intake air temperature and improve the charging efficiency.
- The construction of the gasket consists of resin that is sandwiched between metal gaskets.



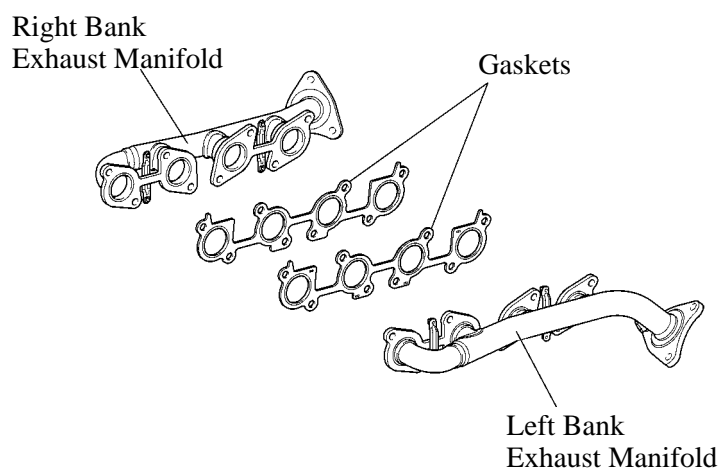
151EG69

**Cross Section**

144EG04

4. Exhaust Manifold

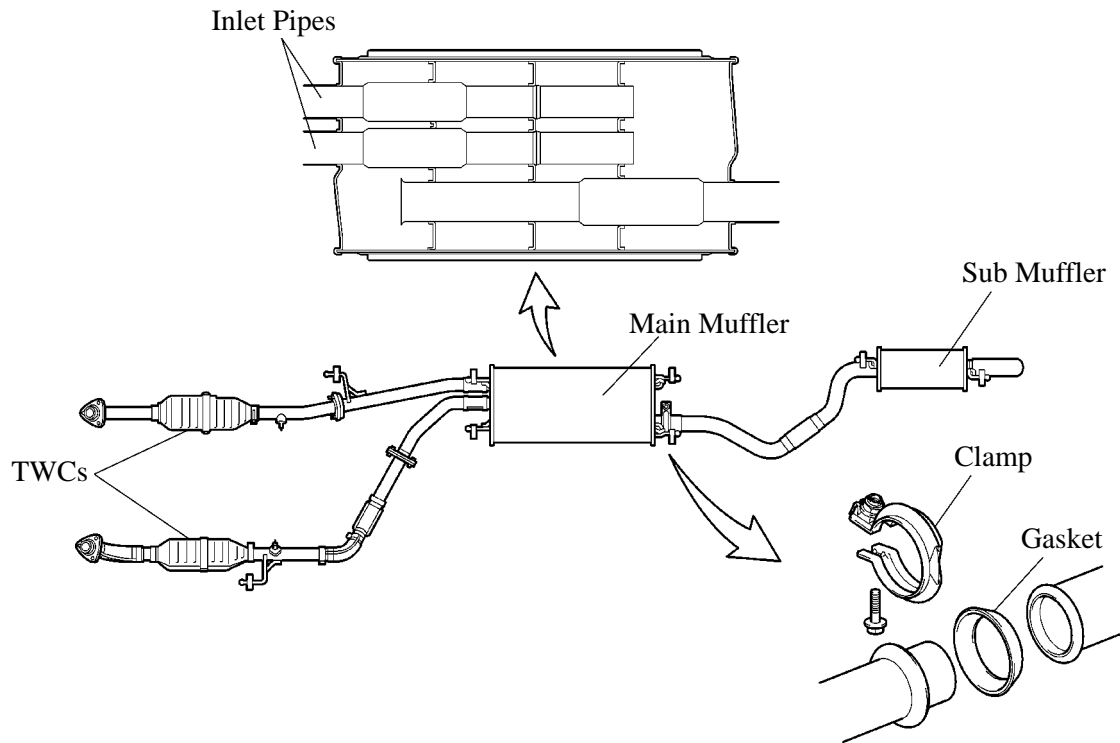
The exhaust manifolds are made of stainless steel for weight reduction.



16156EG04

5. Exhaust Pipe

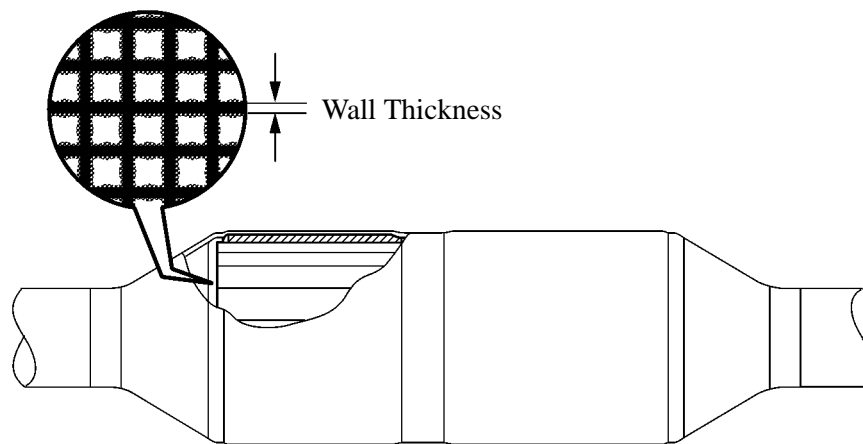
- The exhaust pipe is made of stainless steel for improved rust resistance.
- A clamp type joint is used to join the center pipe and tail pipe to realize weight reduction.
- A TWC (Three-Way Catalytic Converter) that supports the U-LEV (Ultra-Low Emission Vehicle) requirements is provided on each of the right and left banks of the Sequoia.
- To reduce the noise and exhaust resistance due to the exhaust interference that occurs at the area in which the exhaust pipes are joined, the main muffler has adopted a dual inlet pipe configuration.



196EG07

6. TWC (Three-Way Catalytic)

An ultra thin-wall ceramic type front section has been adopted in the TWC. As a result, the thermal capacity of the TWC has been reduced, the warm-up performance of the TWC has been improved, and emissions have been reduced.



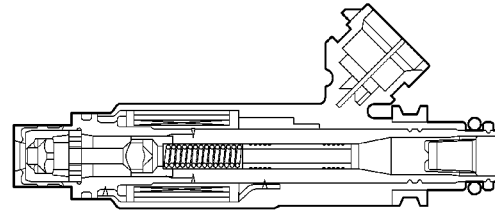
196EG22

◀ FUEL SYSTEM**1. General**

- A fuel cut control is adopted to stop the fuel pump when the airbag is deployed at the front or side collision.
- A tether has been provided on the fuel filler cap to prevent the cap from being lose.
- A compact 4-hole type injector has been adopted to improve the atomization of fuel.
- A quick connector is used to connect the fuel filter and the fuel house together to improve serviceability.

2. Injector

A compact 4-hole type injector has been adopted to improve the atomization of fuel.



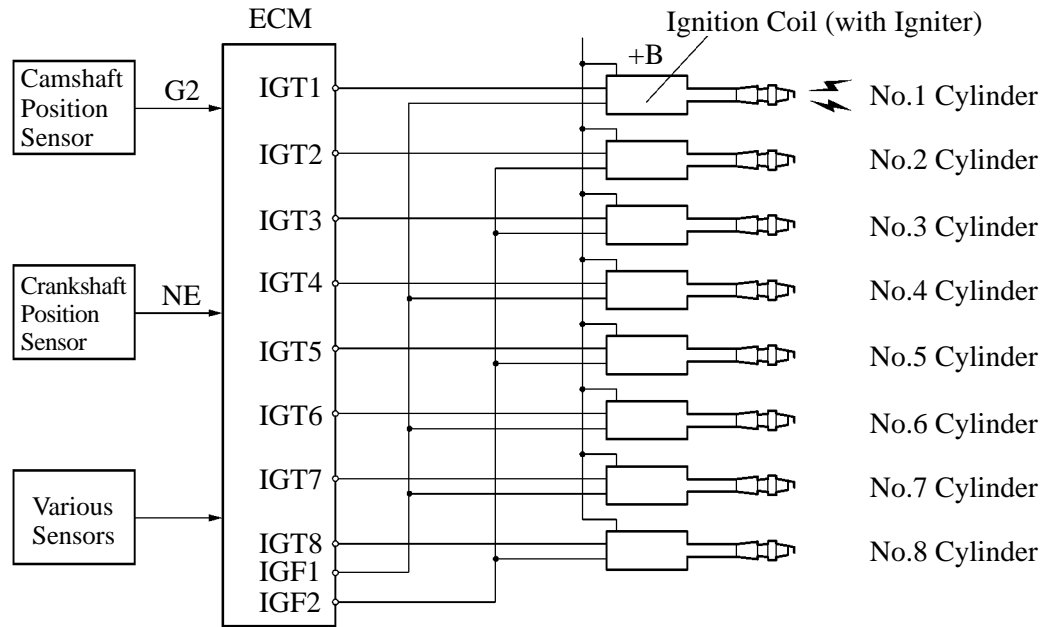
156EG15

● **IGNITION SYSTEM**

1. General

A DIS (Direct Ignition System) has been adopted in the 2UZ-FE engine. The DIS improves the ignition timing accuracy, reduces high-voltage loss, and enhances the overall reliability of the ignition system by eliminating the distributor.

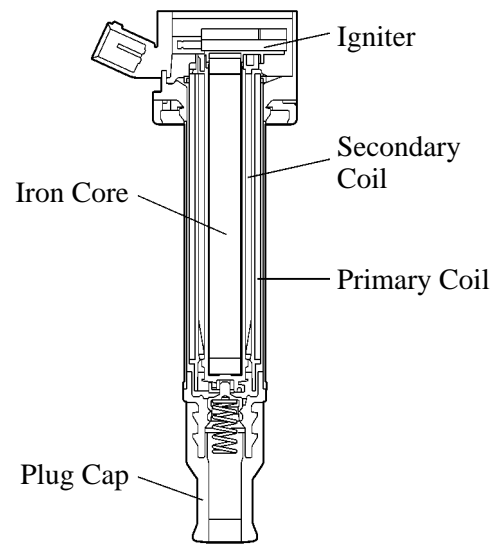
The DIS in 2UZ-FE engine is an independent ignition system which has one ignition coil for each cylinder.



151EG05

2. Ignition Coil

The DIS provides 8 ignition coils, one for each cylinder. The spark plug caps, which provide contact to the spark plugs, are integrated with an ignition coil. Also, an igniter is enclosed to simplify the system.



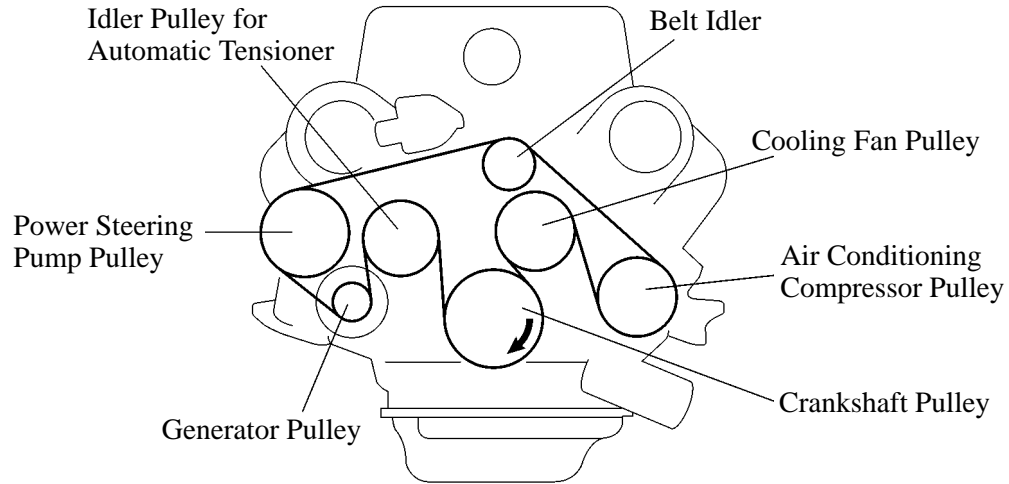
156EG16

Ignition Coil Cross Section

◀ **SERPENTINE BELT DRIVE SYSTEM**

1. General

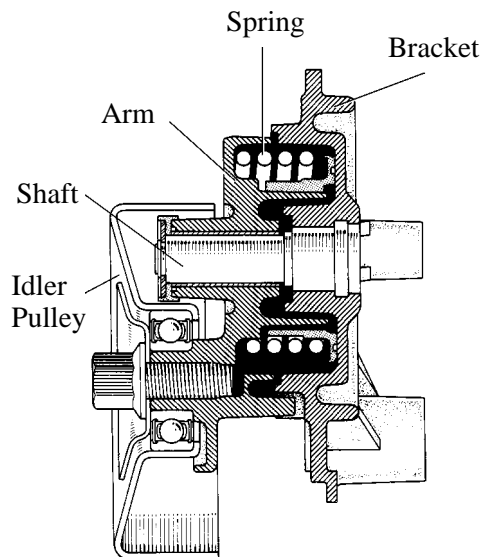
- The serpentine belt drive system drives accessory components with a single V-ribbed belt. It reduces the overall engine length, weight and number of engine parts.
- An automatic tensioner eliminates the need for tension adjustment.



196EG08

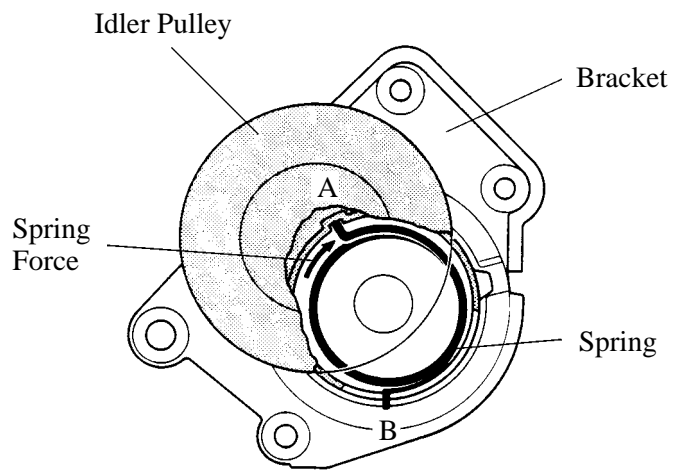
2. Automatic Tensioner

The tension of the V-ribbed belt is properly maintained by the torsion spring that is enclosed in the automatic tensioner.



156EG28

Cross Section



196EG21

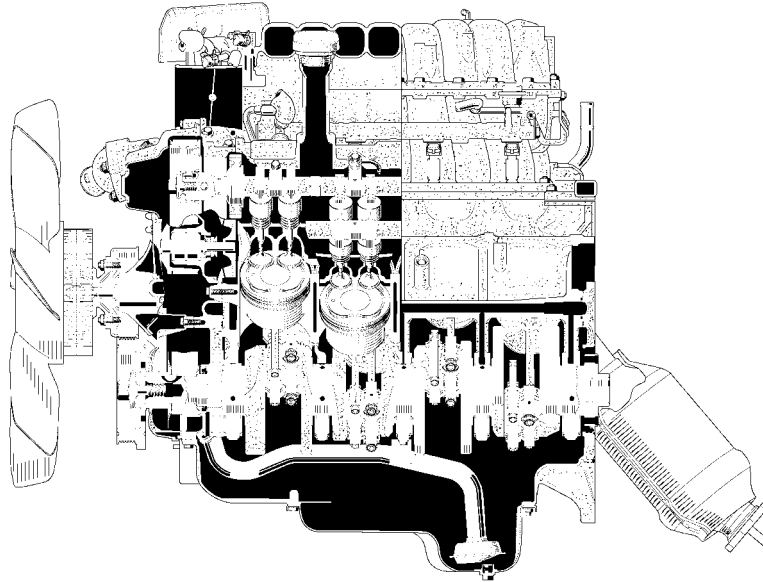
A: Fixed to the Arm
B: Fixed to the Bracket

ENGINE

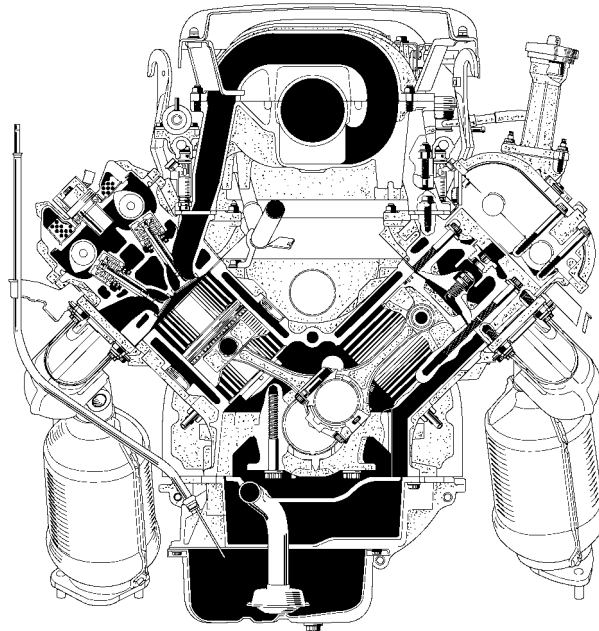
2UZ-FE ENGINE

◦ DESCRIPTION

- The 2UZ-FE engine is a V8, 4.7-liter, 32-valve DOHC engine. This engine has been developed to achieve high performance, quiet operation, and fuel economy. In addition, it has adopted the ETCS-i (Electronic Throttle Control System-intelligent) to ensure excellent controllability of the vehicle and to improve its comfort.
- The basic construction and operation are the same as the 2UZ-FE engine on the '03 Sequoia.
- In contrast to the '02 4Runner, a portion of the evaporative emission control system of the '03 4Runner has been changed in order to comply with the LEV-II (Low Emission Vehicle-II) evaporative emission regulations.



232EG13



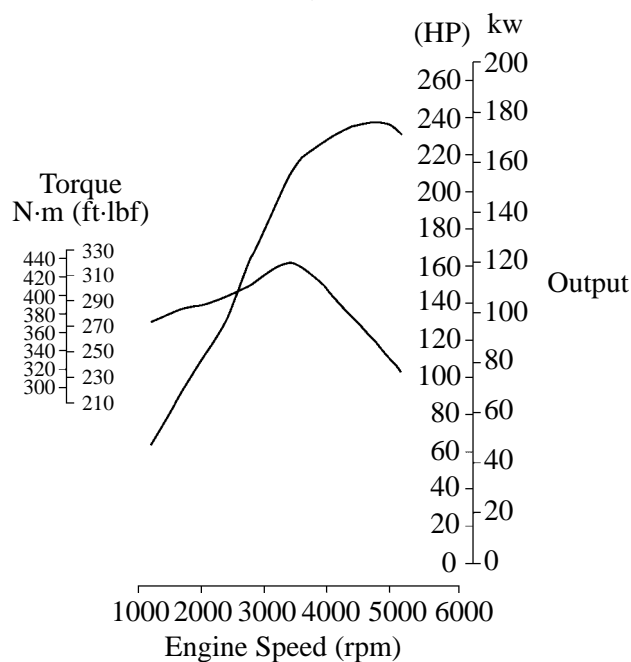
232EG24

● Engine Specifications ◀

Engine Type		2UZ-FE	
No. of Cyls. & Arrangement		8-Cylinder, V Type	
Valve Mechanism		32-Valve DOHC, Belt & Gear Drive (without VVT-i)	
Combination Chamber		Pentroof Type	
Manifolds		Cross-Flow	
Fuel System		SFI	
Displacement	cm ³ (cu. in.)	4664 (284.5)	
Bore × Stroke	mm (in.)	94.0 × 84.0 × (3.70 × 3.31)	
Compression Ratio		9.6 : 1	
Max. Output	(SAE-NET)	175 kW @ 4800 rpm (235 HP @ 4800 rpm)	
Max. Torque	(SAE-NET)	434 N·m @ 3400 rpm (320 ft·lbf @ 3400 rpm)	
Valve Timing	Intake	Open	3° BTDC
		Close	36° ABDC
	Exhaust	Open	46° BBDC
		Close	3° ATDC
Firing Order		1 - 8 - 4 - 3 - 6 - 5 - 7 - 2	
Research Octane Number		96 or higher	
Octane Rating		91 or higher	
Engine Service Mass* (Reference)	kg (lb)	255.5 (562.8)	
Oil Grade		API SL, EC or ILSAC	
Tailpipe Emission Regulation		LEV, SFTP	
Evaporative Emission Regulation		LEV-II, ORVR	

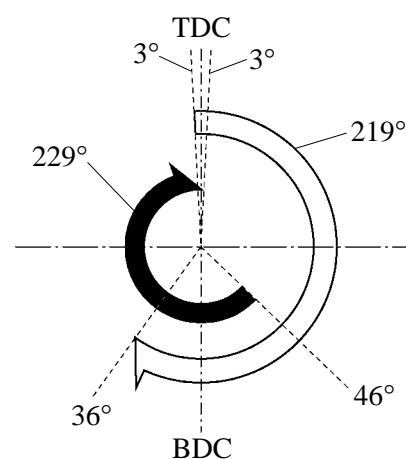
*: Weight shows the figure with the oil and engine coolant fully filled.

● Performance Curve ◀



● Valve Timing ◀

◀ : Intake Valve Opening Angle
 ▶ : Exhaust Valve Opening Angle



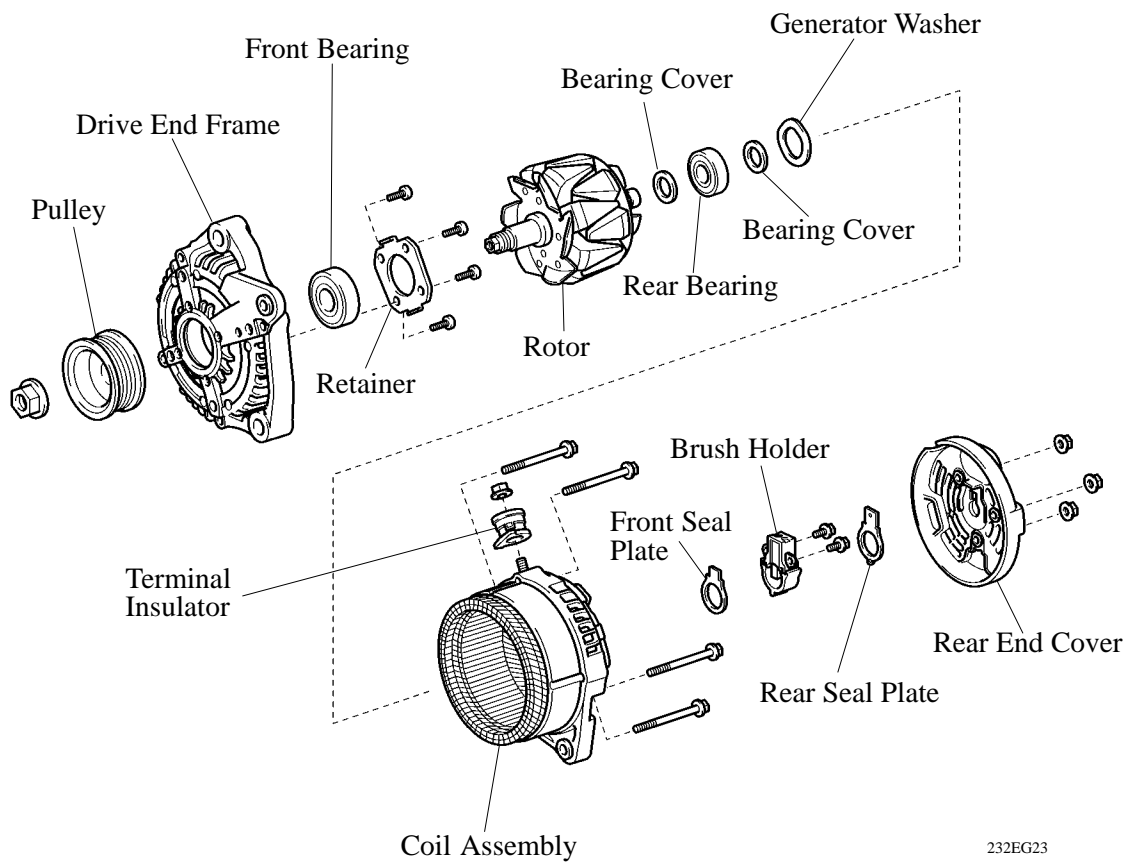
◦ CHARGING SYSTEM

Generator

General

A compact and lightweight Segment Conductor type generator that generates high amperage output in a highly efficient manner has been adopted.

• Component of Segment Conductor Type Generator ◀



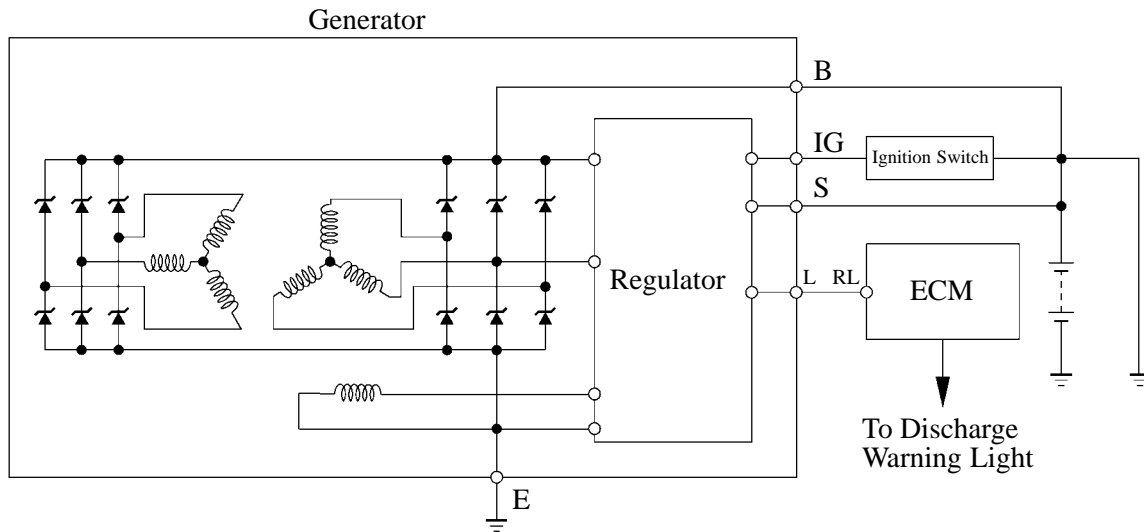
232EG23

Service Tip

Although the charging circuit of a conventional generator is checked through the F terminal, this check cannot be performed on the Segment Conductor type generator through the use of the F terminal because the F terminal has been eliminated.

For details, refer to see the 2003 4Runner Repair Manual (Pub. No. RM1001U).

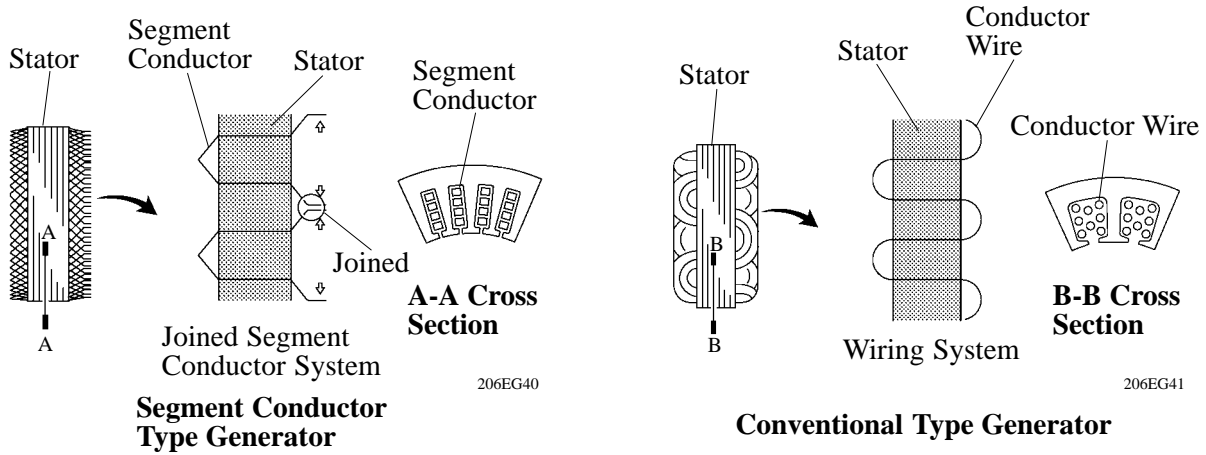
● **Wiring Diagram** ◀



198EG16

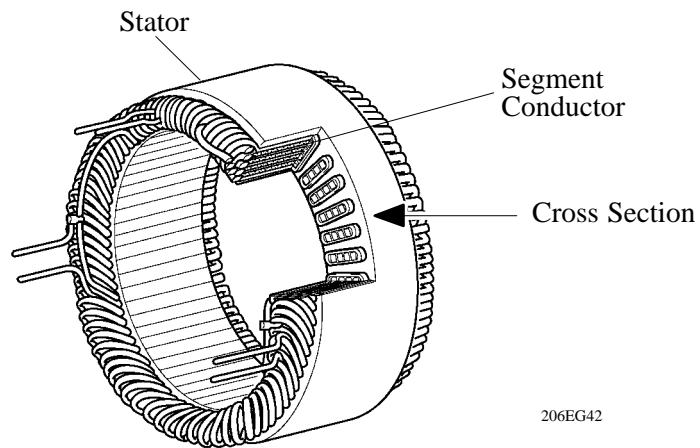
Construction and Operation

■ This generator uses a joined segment conductor system, in which multiple segment conductors are welded together to form the stator. Compared to the conventional winding system, the electrical resistance is reduced due to the shape of the segment conductors, and their arrangement helps to make the generator more compact.



206EG40

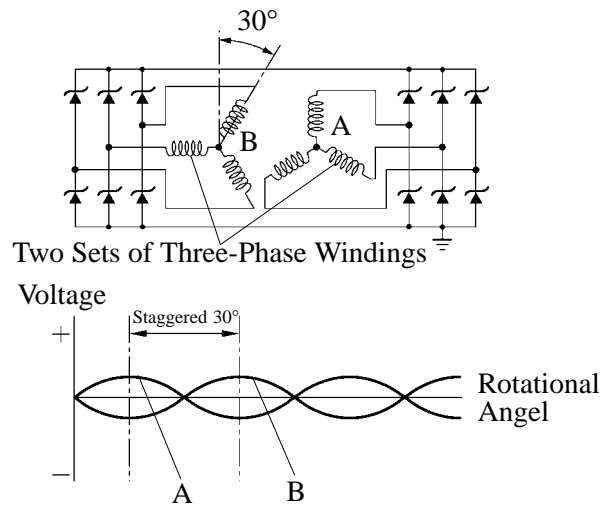
206EG41



206EG42

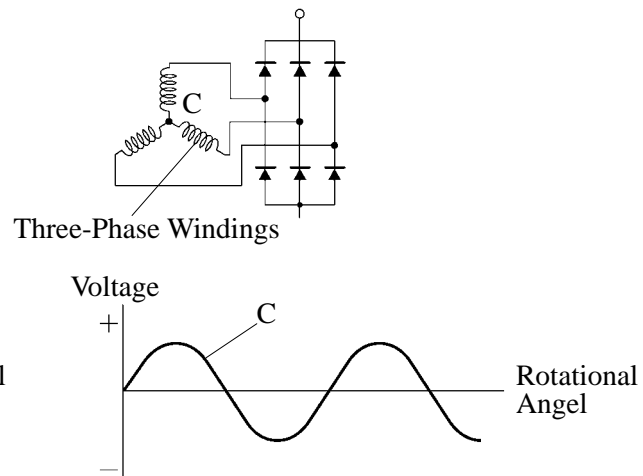
Stator of Segment Conductor Type Generator

■ A dual winding system has been adopted. This system consists of two sets of three-phase windings whose phases are staggered 30°. Because the magnetic fluctuations of the respective windings cancel each other out, magnetic noise, radio frequency interference is reduced.



198EG14

Segment Conductor Type Generator



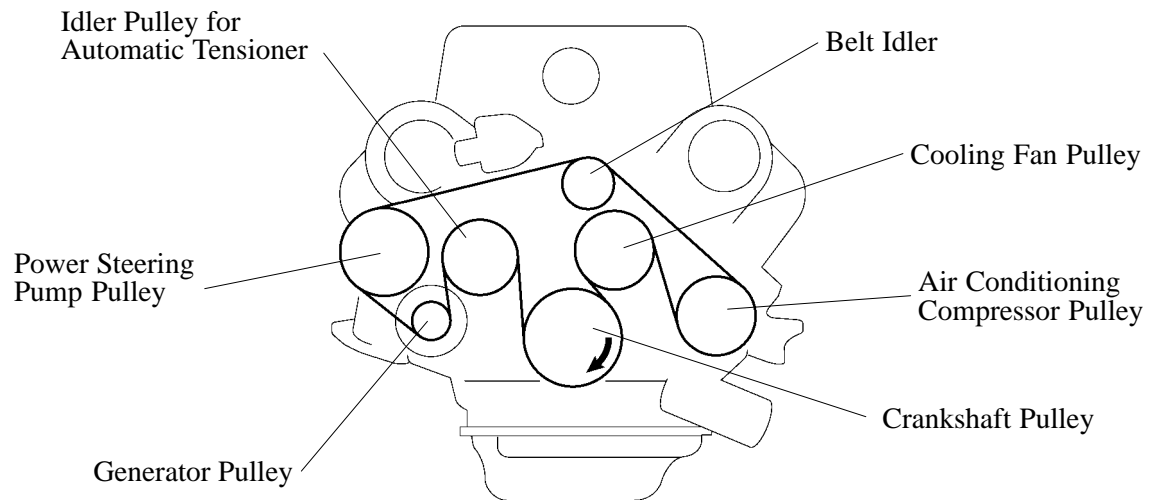
198EG15

Conventional Type Generator

◀ SERPENTINE BELT DRIVE SYSTEM

1. General

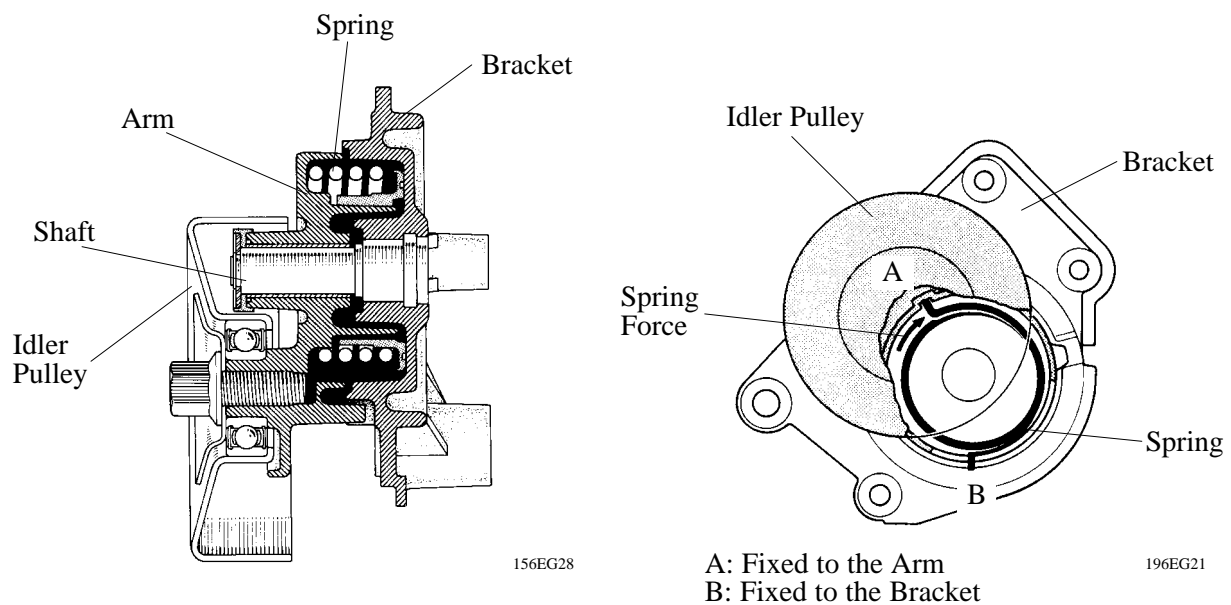
- The serpentine belt drive system drives accessory components with a single V-ribbed belt. It reduces the overall engine length, weight and number of engine parts.
- An automatic tensioner eliminates the need for tension adjustment.



196EG08

2. Automatic Tensioner

The tension of the V-ribbed belt is properly maintained by the tension spring that is enclosed in the automatic tensioner.



156EG28

196EG21

Cross Section

° ENGINE CONTROL SYSTEM

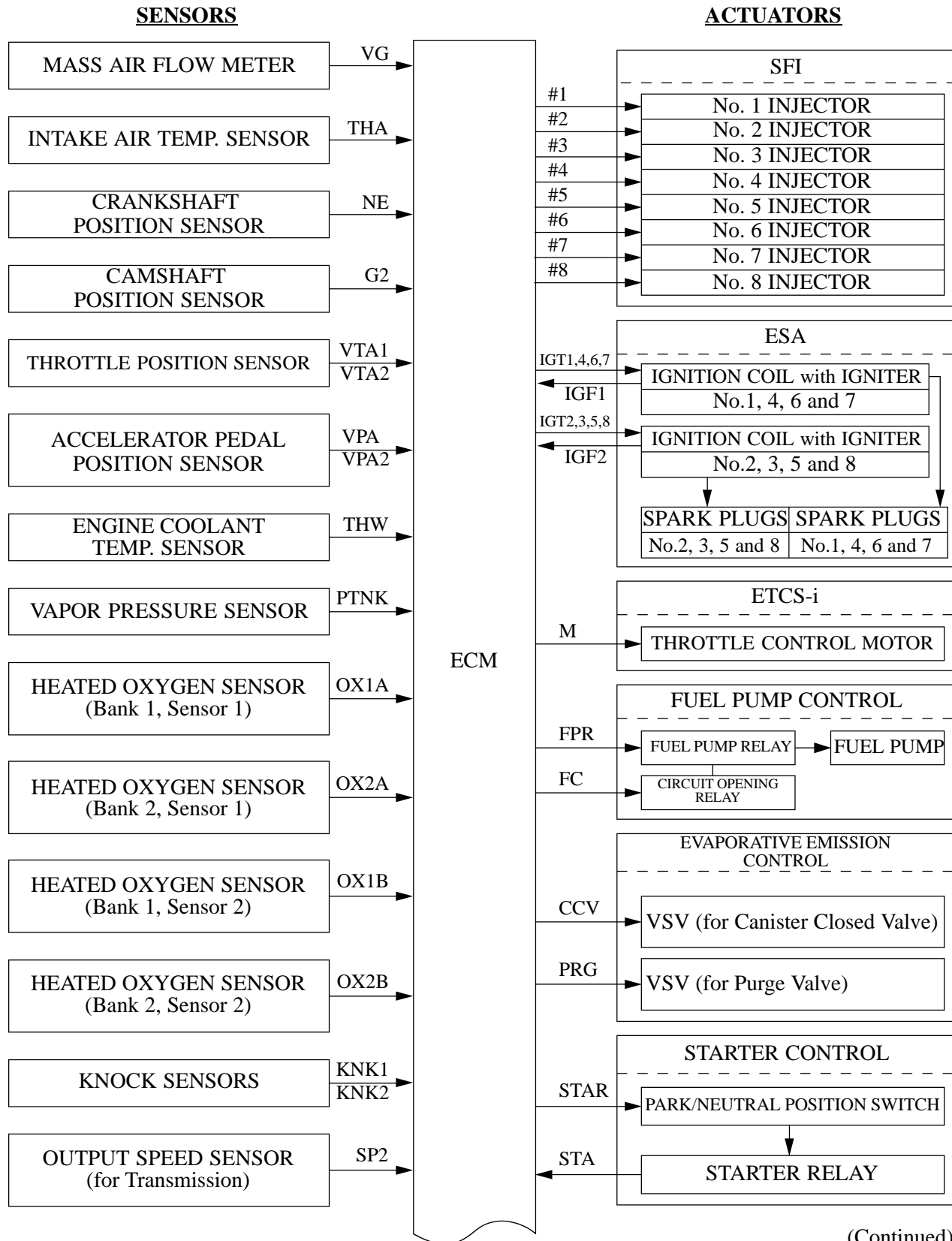
1. General

The engine control system for the 2UZ-FE engine has following system.

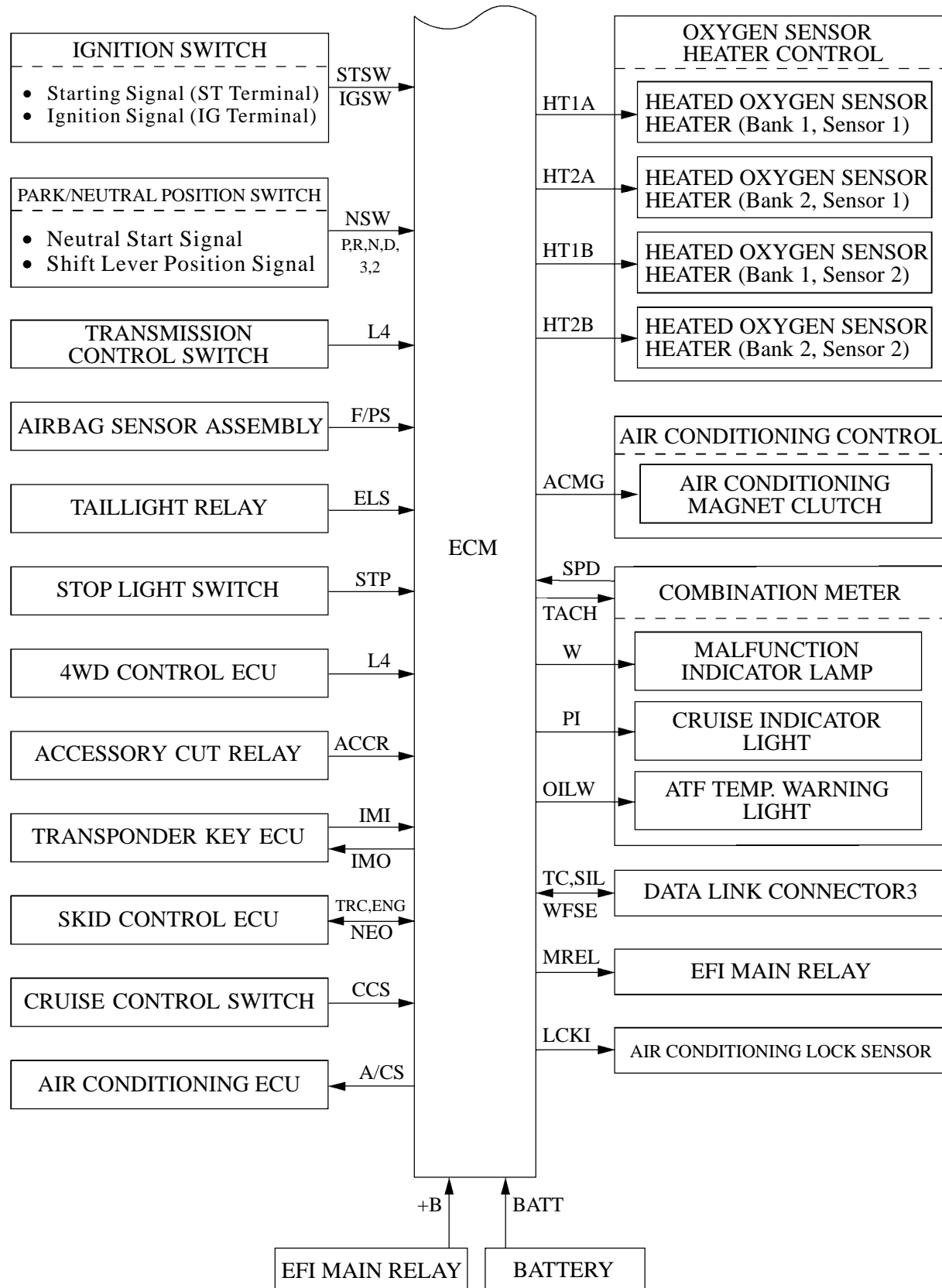
System	Outline
SFI (Sequential Multiport Fuel Injection)	An L-type SFI system directly detects the intake air mass with a hot wire type mass air flow meter.
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on signals from various sensors. The ECM corrects ignition timing in response to engine knocking.
ETCS-i (Electronic Throttle Control System-intelligent) (See page EG-35)	<p>Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the condition of the engine and the vehicle</p> <ul style="list-style-type: none"> • A link-less type is used, without an accelerator cable. • An accelerator pedal position sensor is provided on the accelerator pedal. • A no-contact type throttle position sensor and accelerator pedal position sensor are used.
Fuel Pump Control (See page EG-38)	<p>The fuel pump speed is controlled by the fuel pump relay and the fuel pump resistor.</p> <p>A fuel cut control is adopted to stop the fuel pump when the airbag is deployed during front or side collision.</p>
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.
Evaporative Emission Control (See page EG-39)	<p>The ECM controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.</p> <p>A pressure gauge is attached to the service port, which is provided between the charcoal canister and the VSV (for purge valve), in order to detect an evaporative emission leakage.</p> <p>System construction and control logic have been made to comply with LEV-II evaporative emission regulation.</p>
Air Conditioning Cut-off Control	By turning the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.
Engine Immobiliser	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.
Starter Control (Cranking Hold Function) (See page EG-49)	Once the ignition switch is turned to the START position, this control continues to operate the starter until the engine started.
Diagnosis (See page EG-51)	<p>When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.</p> <p>All the DTCs (Diagnostic Trouble Codes) have been made to correspond to the SAE controlled codes.</p>
Fail-Safe (See page EG-51)	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.

2. Construction

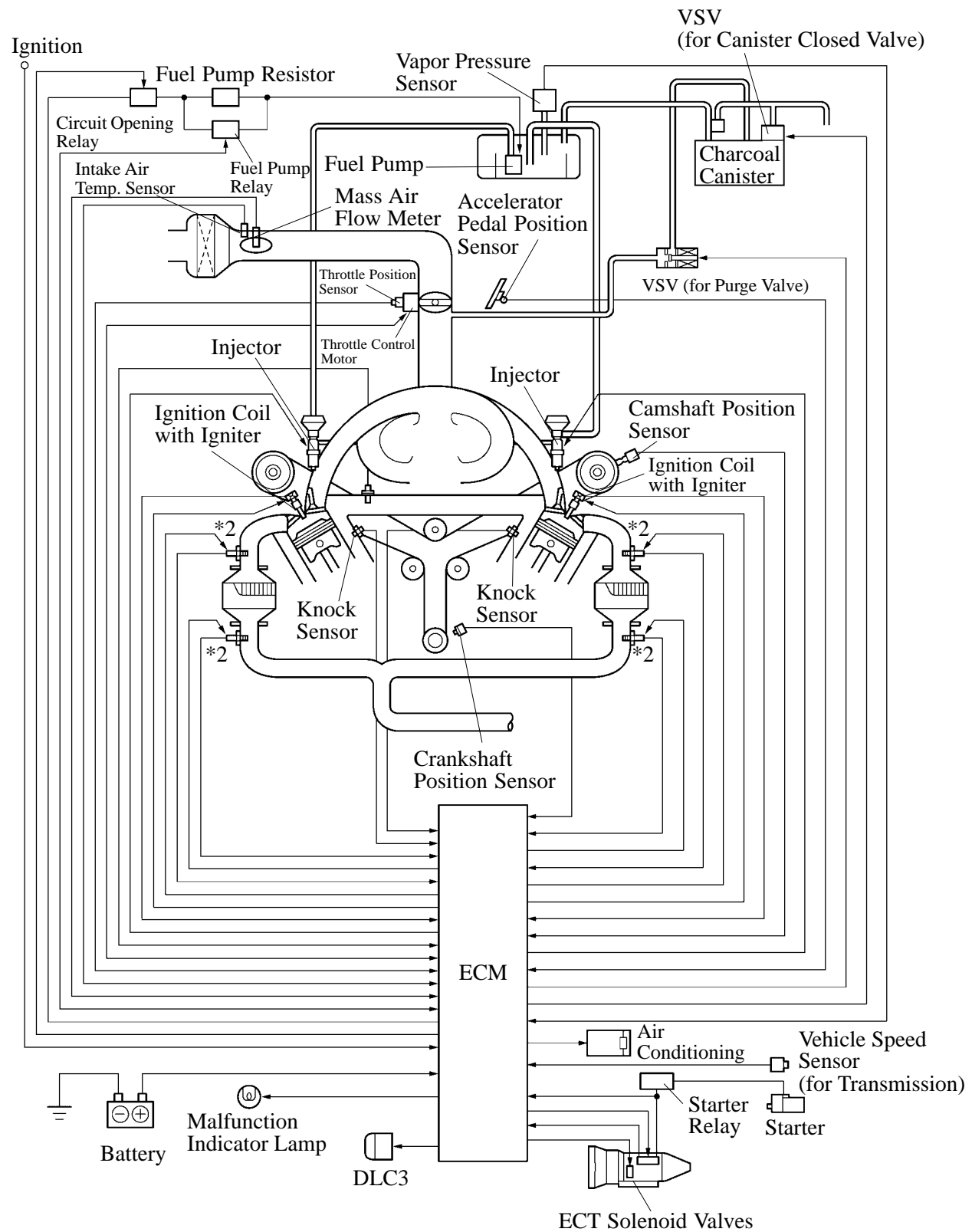
The configuration of the engine control system in the 2UZ-FE engine is shown in the following chart.



(Continued)

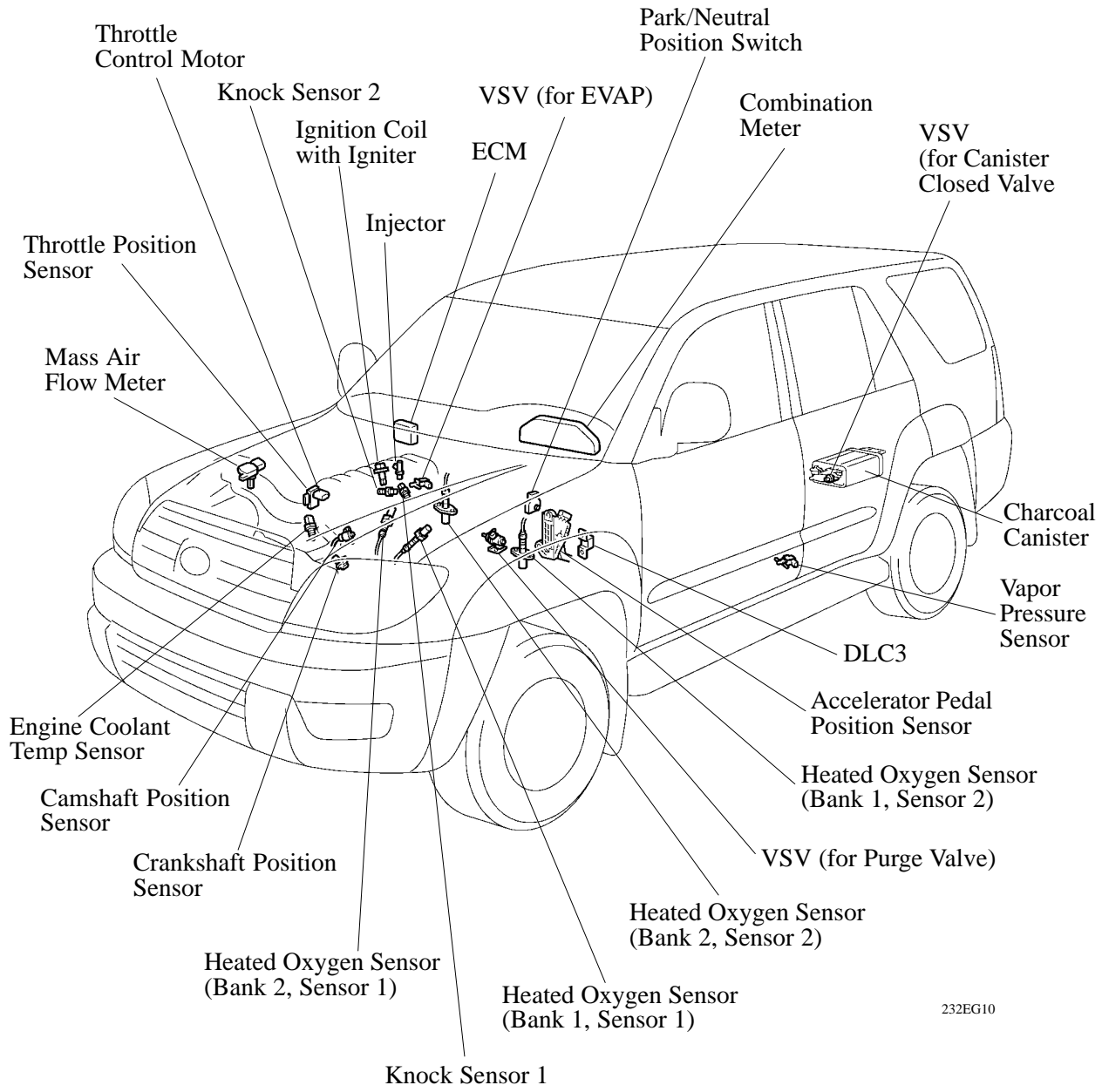


3. Engine Control System Diagram



*1: Engine Coolant Temp. Sensor
 *2: Heated Oxygen Sensor

4. Layout of Main Components



232EG10

5. Main Components of Engine Control System

General

The following table compares the main components.

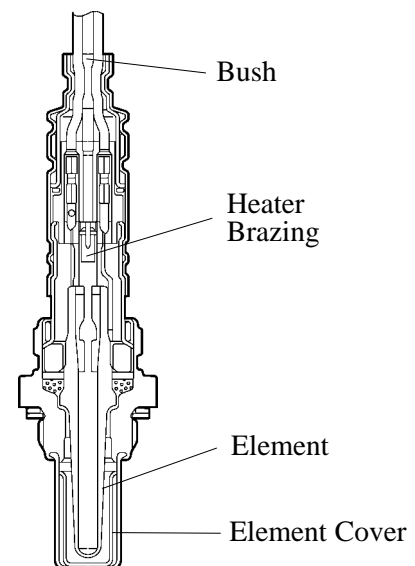
Component		Outline	Quantity
ECM		32-bit CPU	1
Mass Air Flow Meter		Hot-wire Type	1
Crankshaft Position Sensor (Rotor Teeth)		Pick-up Coil Type (36-2)	1
Camshaft Position Sensor (Rotor Teeth)		Pick-up Coil Type (1)	1
Accelerator Pedal Position Sensor		No-contact Type (Mounted on Accelerator Pedal)	1
Throttle Position Sensor		No-contact Type	1
Knock Sensor		Built-in Piezoelectric Type	2
Oxygen Sensor	(Bank 1, Sensor 1) (Bank 2, Sensor 1)	with Heater (Ultra-high temperature resistant type)	2
	(Bank 1, Sensor 2) (Bank 2, Sensor 2)	with Heater (High temperature resistant type)	2
Injector		4-Hole Type	8

ECM

The 32-bit CPU of the ECM has been adopted to increase the speed for processing the signals.

Oxygen Sensor

- An ultra-high temperature resistant oxygen sensor has been adopted for the bank 1/sensor 1 and bank 2/ sensor 1.
- In contrast to the oxygen sensor on the '02 model, this sensor uses ultra-high temperature resistant materials in the following areas: the element, element cover, heater brazing, and bushing.

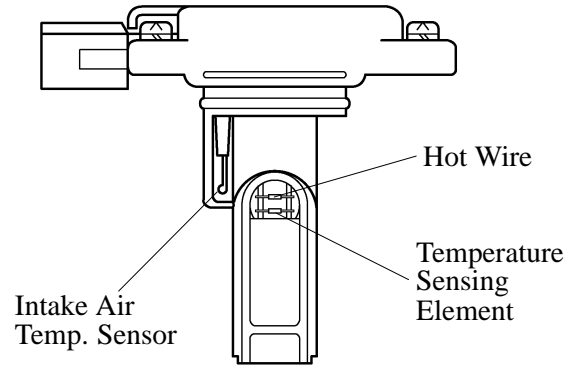


Mass Air Flow Meter

The 2UZ-FE engine uses the hot-wire type mass air flow meter designed for direct electrical measurement of the intake air flow.

This mass air flow meter offers superior measuring precision and its plastic housing is shaped for minimal flow resistance. It has the following features:

- Compact and lightweight
The pressure loss caused by this sensor is small and offers only slight intake air flow resistance.
- Superior response and measuring accuracy.
- Ability to measure a wide airflow range.
- Having no mechanical functions, it offers superior durability.



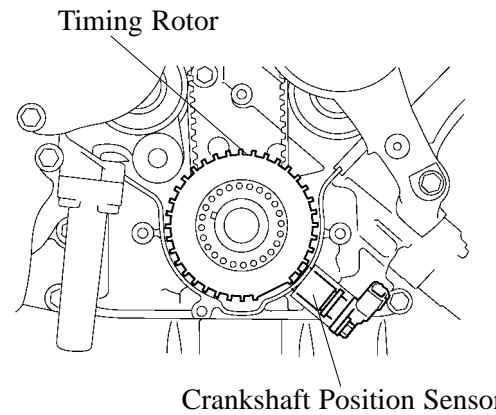
140EG45

Crankshaft Position Sensor

The crankshaft position sensor is mounted on the oil pump body as illustrated below.

The rotor's teeth are spaced 10° apart, according to crankshaft angle, but since there are 2 teeth missing, as illustrated below, there is a total of 34 teeth.

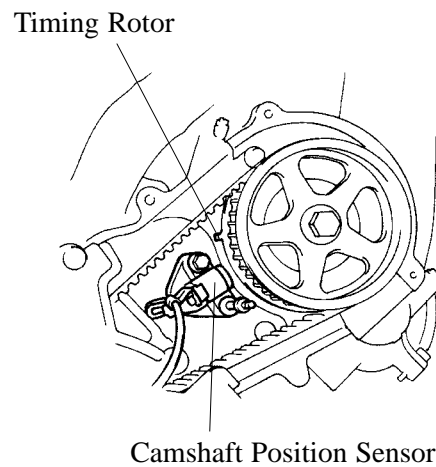
Accordingly, the ECM can detect the crankshaft angle in addition to the crankshaft speed.



151EG18

Camshaft Position Sensor

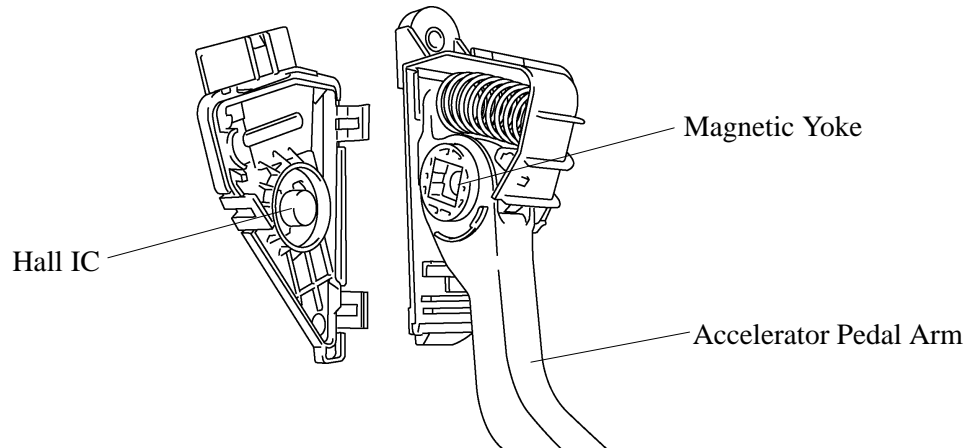
The camshaft position sensor is mounted on the left bank cylinder head. To detect the camshaft position, a protrusion that is provided on the timing pulley is used to generate 1 pulse for every 2 revolutions of the camshaft.



156EG26

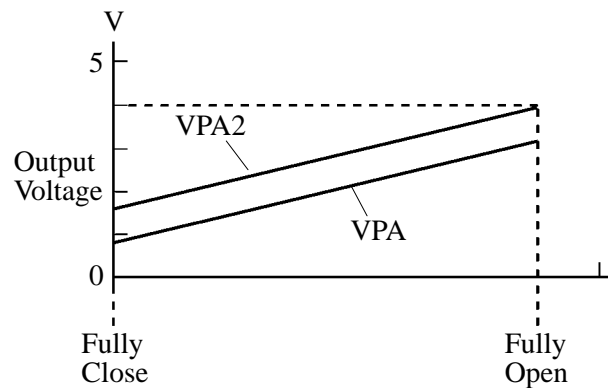
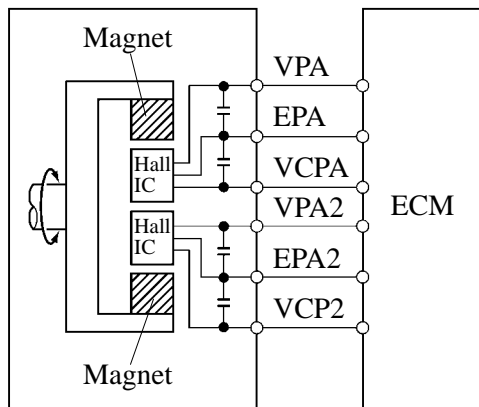
Accelerator Pedal Position Sensor

The magnetic yoke that is mounted at the base of the accelerator pedal arm rotates around the Hall IC in accordance with the amount of effort that is applied to the accelerator pedal. The Hall IC converts the changes in the magnetic flux that occur at that time into electrical signals, and outputs them in the form of accelerator pedal position to the ECM.



228TU23

Accelerator Pedal
Position Sensor



Accelerator Pedal Depressed Angle

228TU24

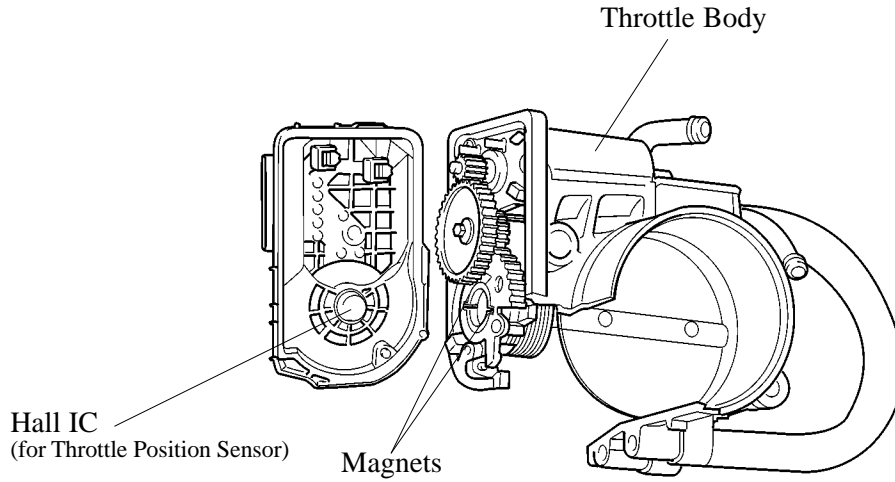
228TU25

Service Tip

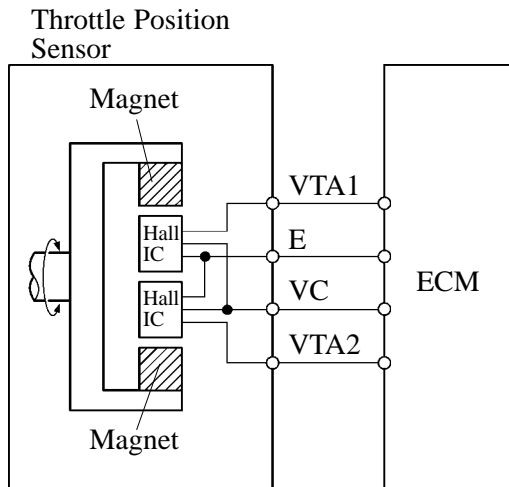
The inspection method differs from the conventional accelerator pedal position sensor because this sensor uses a hall IC. For details, refer to the 2003 4Runner Repair Manual (Pub. No. RM1001U.)

Throttle Position Sensor

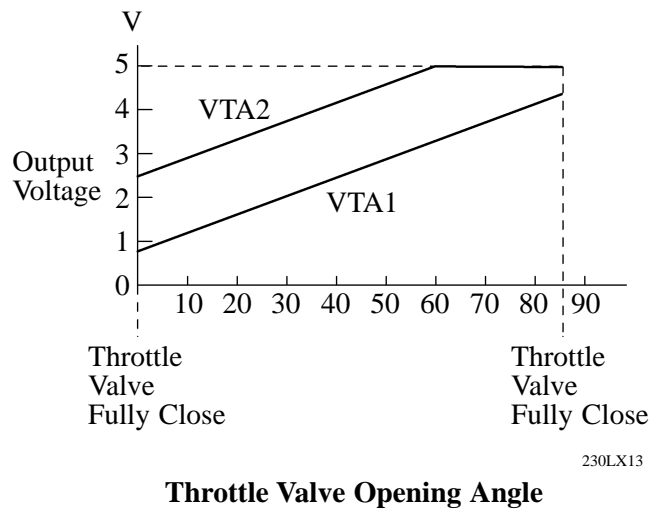
The throttle position sensor is mounted on the throttle body, to detect the opening angle of the throttle valve, the throttle position sensor converts the magnetic flux density that changes when the magnetic yoke (located on the same axis as the throttle shaft) rotates around the Hall IC into electric signals to operate the throttle control motor.



229LC108



230LX12



230LX13

Service Tip

The inspection method differs from the conventional throttle position sensor because this sensor uses a Hall IC. For details, refer to the 2003 4Runner Repair Manual (Pub. No. RM1001U.)

6. ETCS-i (Electronic Throttle Control System-intelligent)

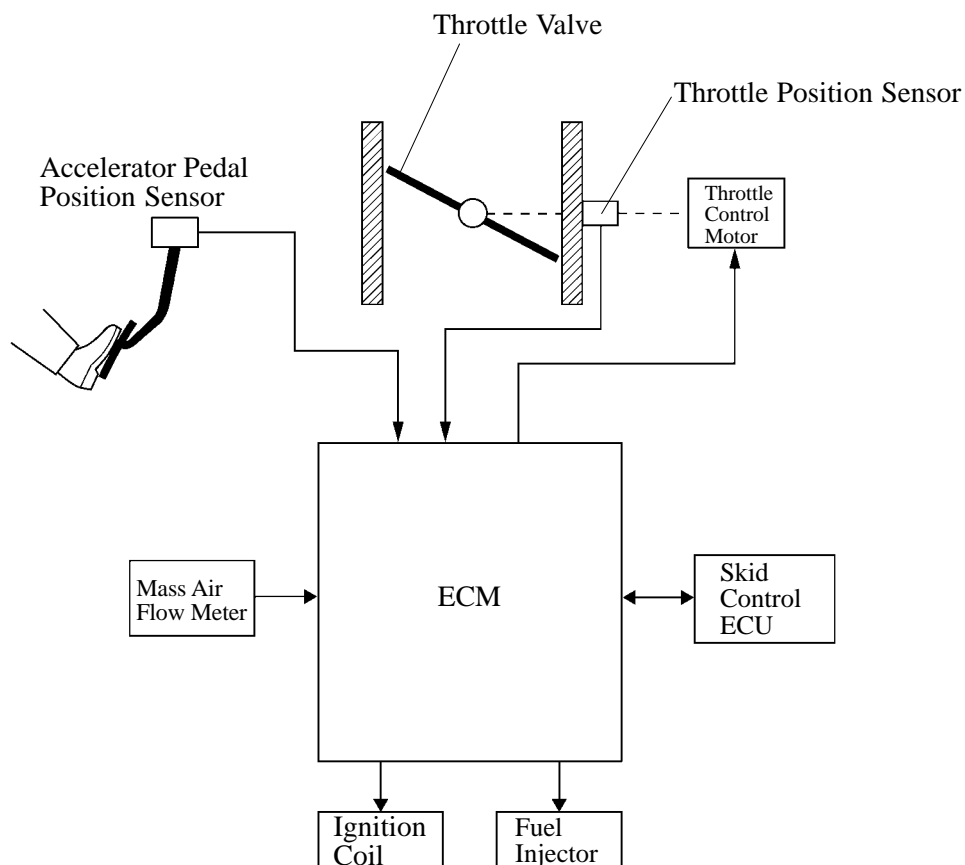
General

- The ETCS-i is used, providing excellent throttle control in all the operating ranges.
In the new 2UZ-FE engine, the accelerator cable has been discontinued, and an accelerator position sensor has been provided on the accelerator pedal.
- In the conventional throttle body, the throttle valve opening is determined by the amount of the accelerator pedal effort. In contrast, the ETCS-i uses the ECM to calculate the optimal throttle valve opening that is appropriate for the respective driving condition and uses a throttle control motor to control the opening.
- The ETCS-i controls the ISC (Idle Speed Control) system, the cruise control system, the TRAC*¹ (Traction Control) / A-TRAC*² (Active-Traction Control), and the VSC (Vehicle Skid Control) system.
- In case of an abnormal condition, this system transfers to the limp mode. For details, refer to the Fail-Safe section on page EG-51.

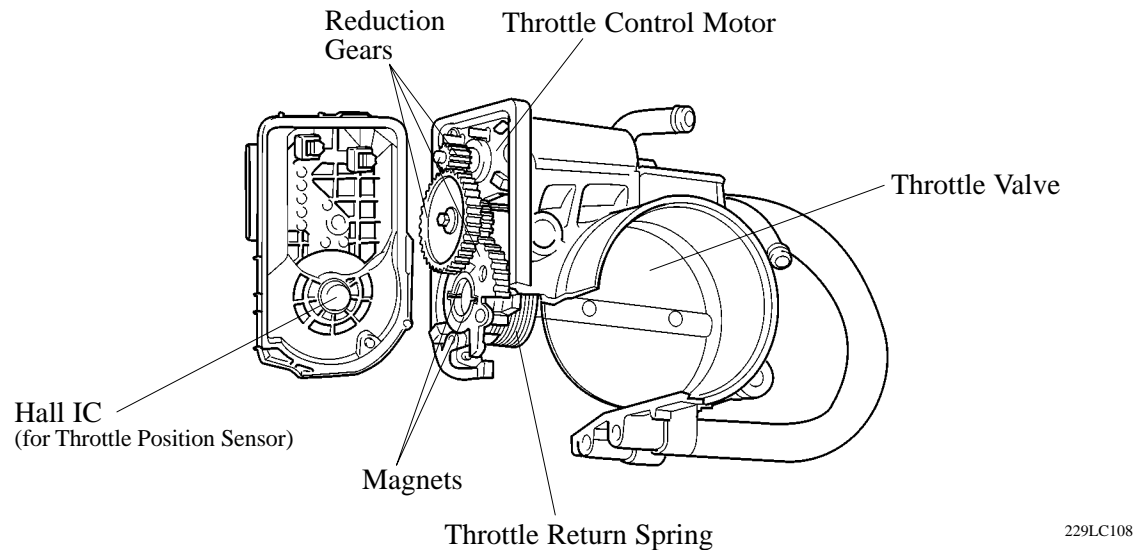
*1: Only for the 2WD model

*2: Only for the 4WD model

● System Diagram ◀



Construction



1) Throttle Position Sensor

The throttle position sensor is mounted on the throttle body, to detect the opening angle of the throttle valve. For details, refer to Main Components of Engine Control System section on page EG-34.

2) Throttle Control Motor

A DC motor with excellent response and minimal power consumption is used for the throttle control motor. The ECM performs the duty ratio control of the direction and the amperage of the current that flows to the throttle control motor in order to regulate the opening of the throttle valve.

Operation

1) General

The ECM drives the throttle control motor by determining the target throttle valve opening in accordance with the respective operating condition.

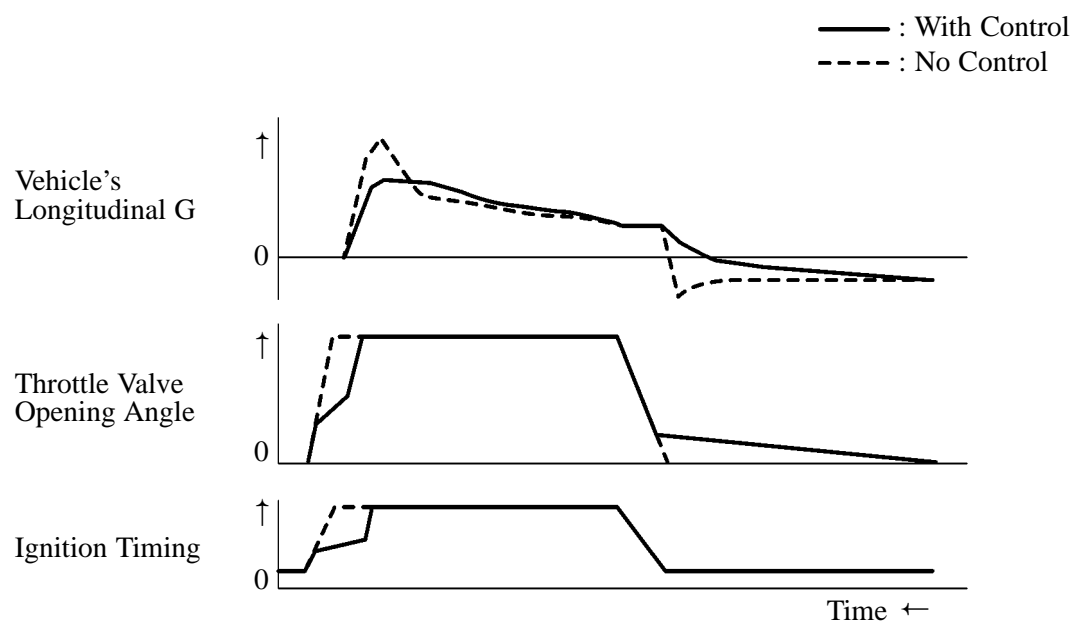
- 1) Non-Linear Control
- 2) Idle Speed Control
- 3) TRAC or A-TRAC* Throttle Control
- 4) VSC Coordination Control
- 5) Cruise Control

*: with A-TRAC system (4WD model)

2) Non-Linear Control

Controls the throttle to an optimal throttle valve opening that is appropriate for the driving condition such as the amount of the accelerator pedal effort and the engine speed in order to realize excellent throttle control and comfort in all operating ranges.

• Control Examples During Acceleration and Deceleration ◀



150EG37

3) Idle Speed Control

The ECM controls the throttle valve in order to constantly maintain an ideal idle speed.

4) TRAC or A-TRAC* Control

As part of the TRAC or A-TRAC* system, the throttle valve is closed by a demand signal from the skid control ECU if an excessive amount of slippage is created at a driving wheel, thus facilitating the vehicle in ensuring stability and driving force.

* : with A-TRAC system (4WD model)

5) VSC Coordination Control

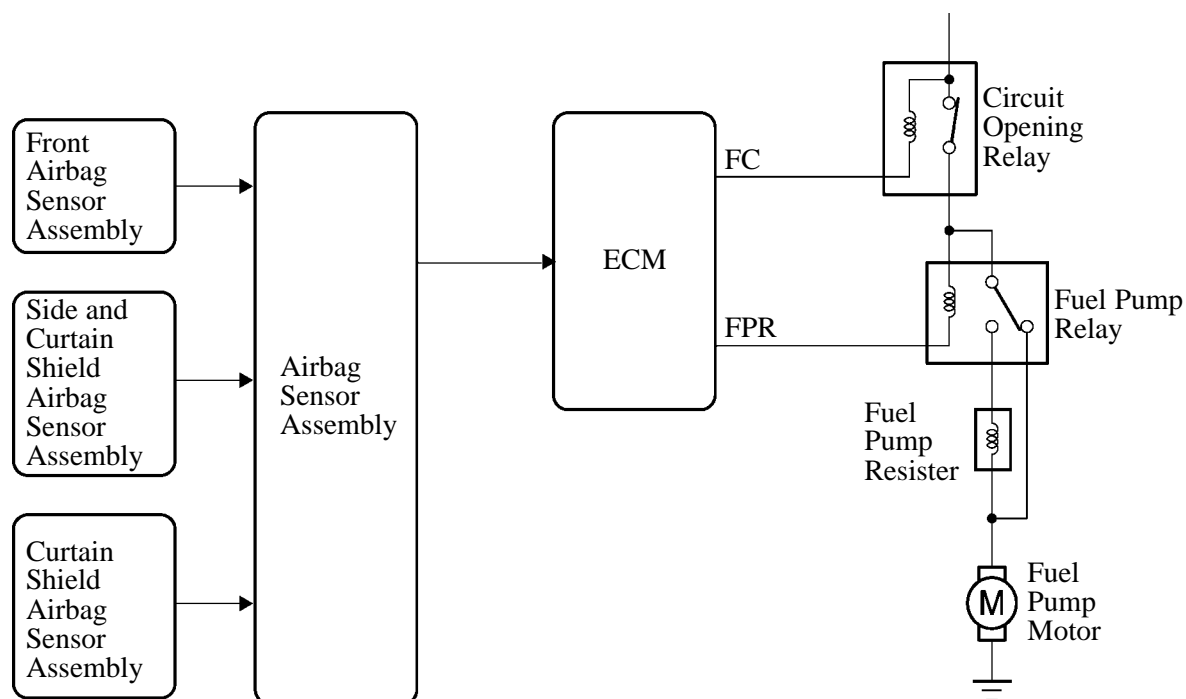
In order to bring the effectiveness of the VSC system control into full play, the throttle valve opening angle is controlled by effecting a coordination control with the skid control ECU.

6) Cruise Control

An ECM with an integrated cruise control ECU directly actuates the throttle valve for operation of the cruise control.

7. Fuel Pump Control

- A fuel pump speed is controlled by the fuel pump relay and the fuel pump resister.
- A fuel cut control is adopted to stop the fuel pump when the airbag is deployed at the front or side collision. In this system, the airbag deployment signal from the airbag sensor assembly is detected by the ECM, which turns OFF the circuit opening relay. After the fuel cut control has been activated, turning the ignition switch from OFF to ON cancels the fuel cut control, and the engine can be restarted.



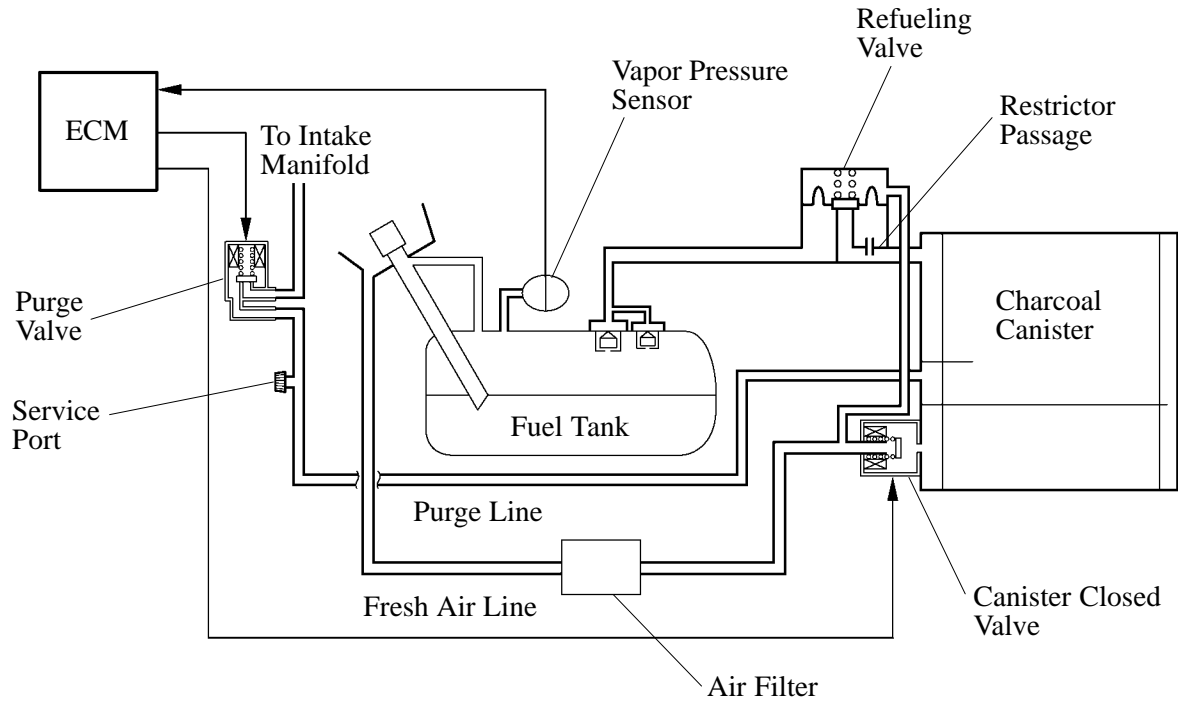
8. Evaporative Emission Control System

General

- The construction of the evaporative emission control system has been changed to comply with the LEV-II (Low Emission Vehicle-II) CARB (California Air Resources Board) evaporative emission regulation. Along with this change, the amount of vapor gas that is discharged outside of the vehicle while the vehicle is parked has been reduced considerably. Because of this construction, which is simpler than the previous, the reliability of the system has been improved.
- This system consists primarily of a canister closed valve, purge valve, charcoal canister, vapor pressure sensor, refueling valve, and ECM.
- In this system, the ECM monitors the system for malfunctions and outputs DTCs (Diagnostic Trouble Codes) in the event of a malfunction. The detection method is basically the same as the conventional vacuum type that is used on other models. A vacuum is introduced into the system, and the amount of increase in the internal pressure of the fuel tank is monitored in order to detect any leakage in the system.
- Listed below are the construction differences between this system and the conventional vacuum type:
 - 1) The air drain valve has been discontinued. The air that has been cleaned through the charcoal canister is discharged through the fresh air line. Accordingly, the fresh air inlet has been moved from the air cleaner to a location near the fuel inlet. Furthermore, the pipe diameter of the fresh air line and the flow rate of the canister closed valve have been increased.
 - 2) An ORVR (Onboard Refueling Vapor Recovery) function has been provided in the refueling valve.
 - 3) A restrictor passage has been provided in the refueling valve to prevent the large amount of vacuum during purge operation or system monitoring operation from affecting the pressure in the fuel tank. As a result of this construction, the pressure switching valve has been discontinued.
 - 4) An air filter* has been added to the fresh air line.

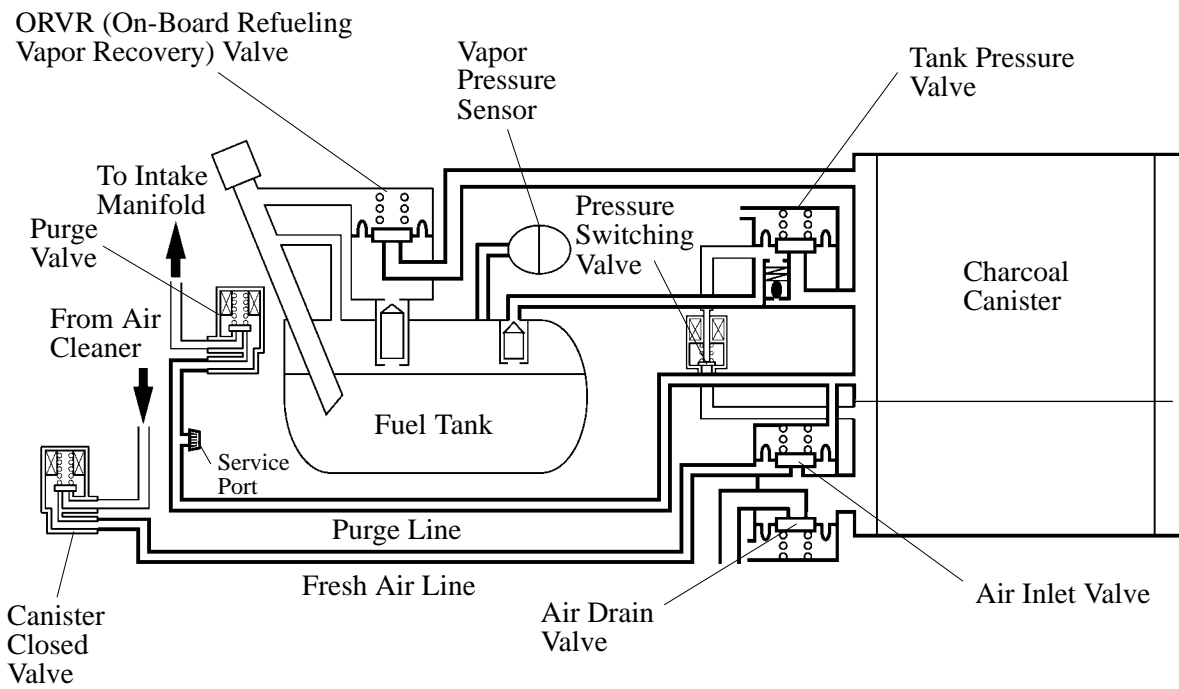
*: The air filter is maintenance-free. If the filter becomes clogged, the ECM will illuminate the MIL (Malfunction Indicator Lamp) and record the DTC number P0446 in its memory.

● System Diagram ◀



'03 4Runner

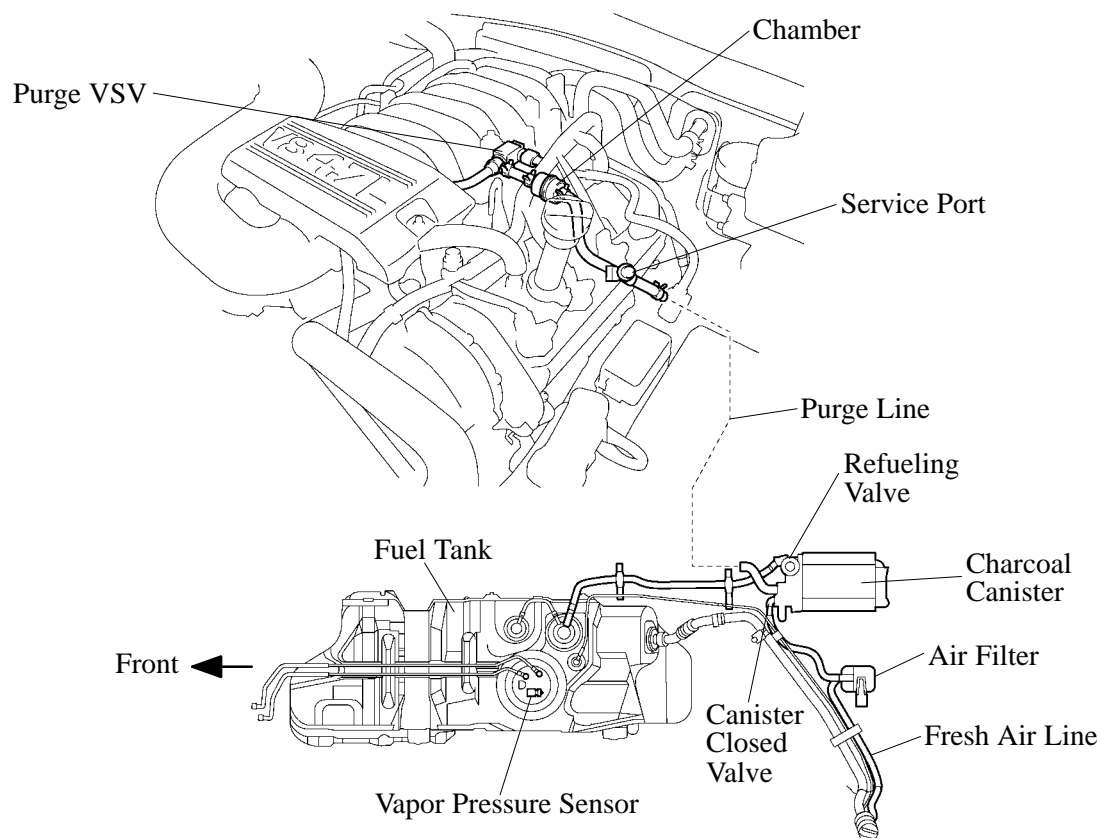
232EG18



Conventional Vacuum Type

189EG31

Layout of Main Component



232EG12

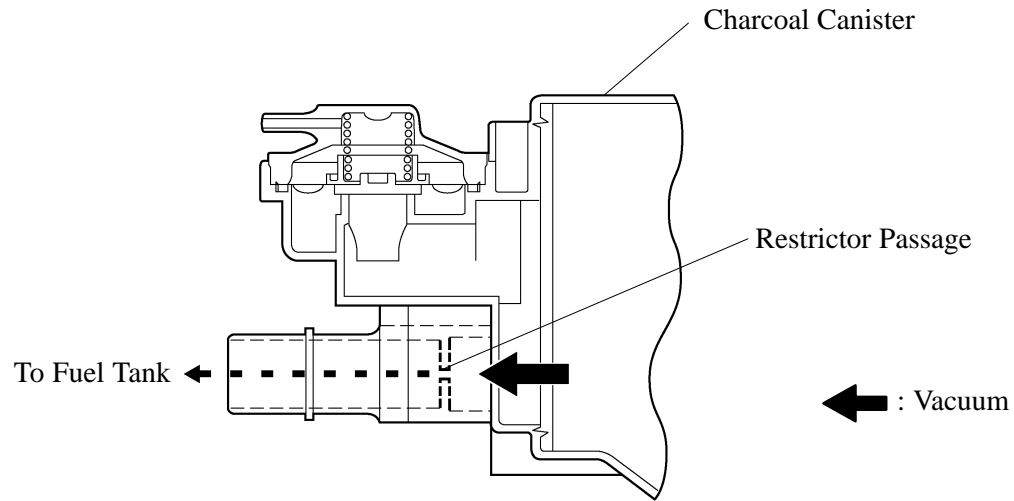
Function of Main Component

Components	Function
Canister Closed Valve	Opens and closes the fresh air line in accordance with the signals from the ECM in order to introduce fresh air and control the pressure relief if the internal pressure in the fuel tank increases.
Purge Valve	Opens in accordance with the signals from the ECM when the system is purging, in order to send the vapor gas that was absorbed by the charcoal canister into the intake manifold. During the system monitoring mode, this valve controls the introduction of the vacuum into the fuel tank.
Charcoal Canister	Contains activated charcoal to absorb the vapor gas that is created in the fuel tank.
Vapor Pressure Sensor	Detects the pressure in the fuel tank and sends the signals to the ECM.
Refueling Valve	Controls the flow rate of the vapor gas from the fuel tank to the charcoal canister when the system is purging or during refueling.
Air Filter	Prevents dust and debris in the fresh air from entering the system.
Service Port	This port is used for connecting a vacuum gauge for inspecting the system.
ECM	Controls the canister closed valve and the purge valve in accordance with the signals from various sensors, in order to achieve a purge volume that suits the driving conditions. In addition, the ECM monitors the system for any leakage and outputs a DTC if a malfunction is found.

Construction and Operation

1) Refueling Valve

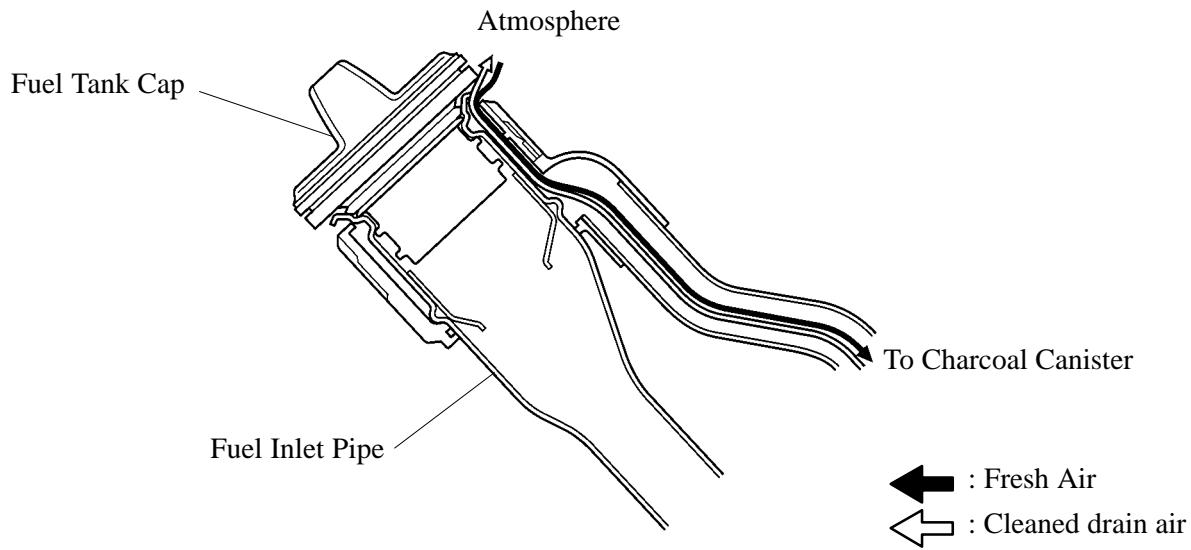
A restrictor passage has been provided in the tank pressure valve. The restrictor passage prevents the large amount of vacuum that is created during purge operation or system monitoring operation from entering the fuel tank, and limits the flow of the vapor gas from the fuel tank to the charcoal canister. If a large volume of vapor gas recirculates into the intake manifold, it will affect the air-fuel ratio control of the engine. Therefore, the role of the restrictor passage is to prevent this from occurring.



228TU117

2) Fuel Inlet (Fresh Air Inlet)

In accordance with the change of structure of the evaporative emission control system, the location of a fresh air line inlet has been changed from the air cleaner section to near the fuel inlet. The fresh air from the atmosphere and drain air cleaned by the charcoal canister will go in and out to the system through the passage shown below.



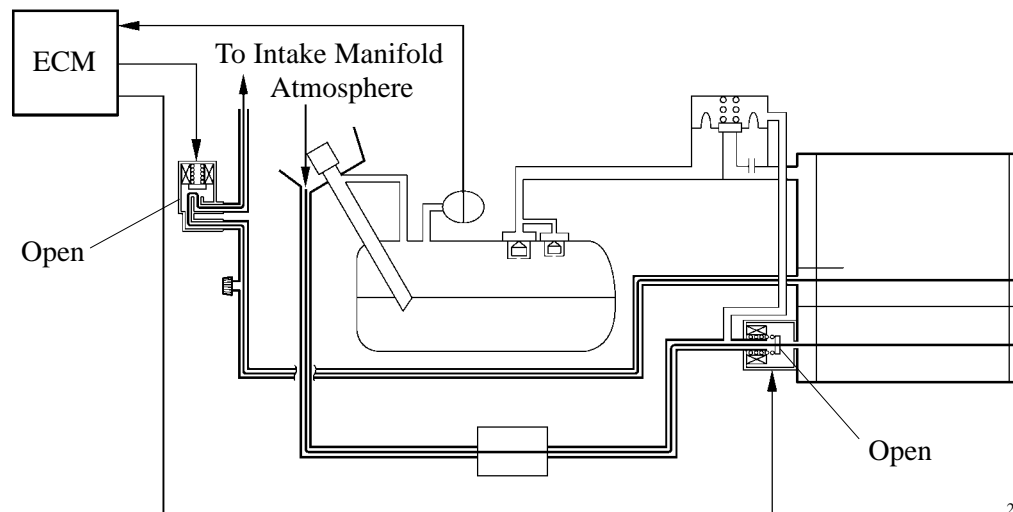
228TU119

System Operation

1) Purge Flow Control

When the engine has reached predetermined parameters (closed loop, engine coolant temp. above 75°C (167°F) , etc), stored fuel vapors are purged from the charcoal canister whenever the purge valve is opened by the ECM.

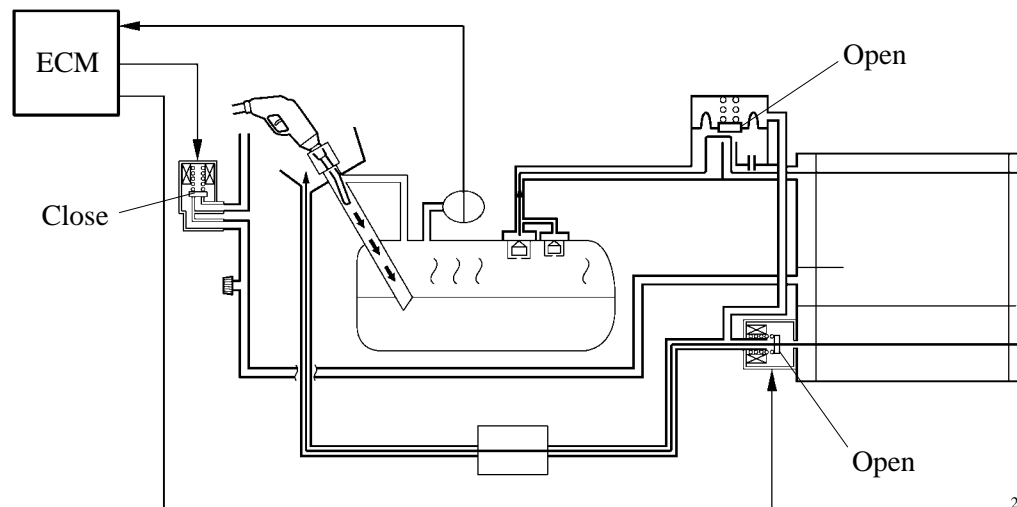
The ECM will change the duty ratio cycle of the purge valve thus controlling purge flow volume. Purge flow volume is determined by intake manifold pressure and the duty ratio cycle of the purge valve. Atmospheric pressure is allowed into the charcoal canister to ensure that purge flow is constantly maintained whenever purge vacuum is applied to the charcoal canister.



232EG19

2) ORVR (On-Board Refueling Vapor Recovery)

When the internal pressure of the fuel tank increases during refueling, this pressure causes the diaphragm in the refueling valve to lift up, allowing the fuel vapors to enter the charcoal canister. Because the canister closed valve is always open (even when the engine is stopped) when the system is in a mode other than the monitoring mode, the air that has been cleaned through the charcoal canister is discharged outside of the vehicle via the fresh air line. If the vehicle is refueled during the system monitoring mode, the ECM will recognize the refueling by way of the vapor pressure sensor, which detects the sudden pressure increase in the fuel tank, and will open the canister closed valve.



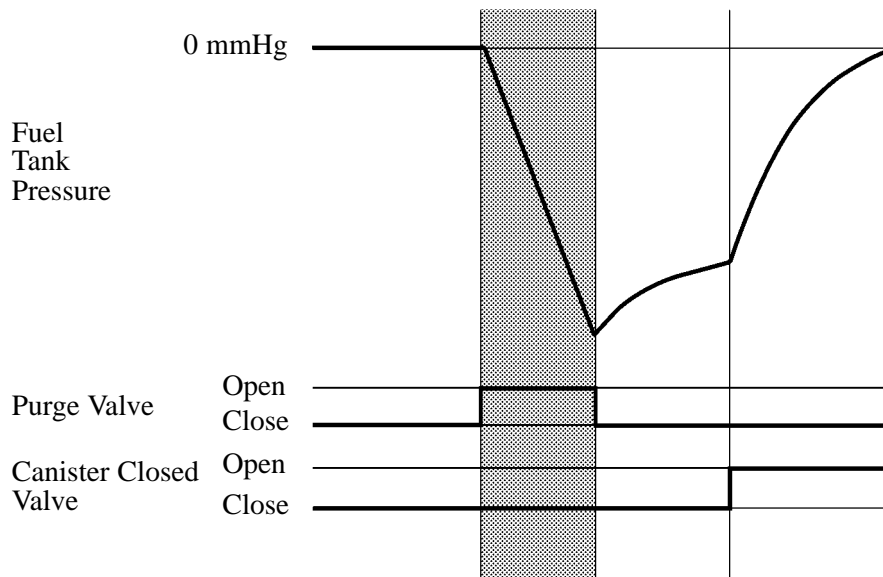
232EG20

3) System Monitoring

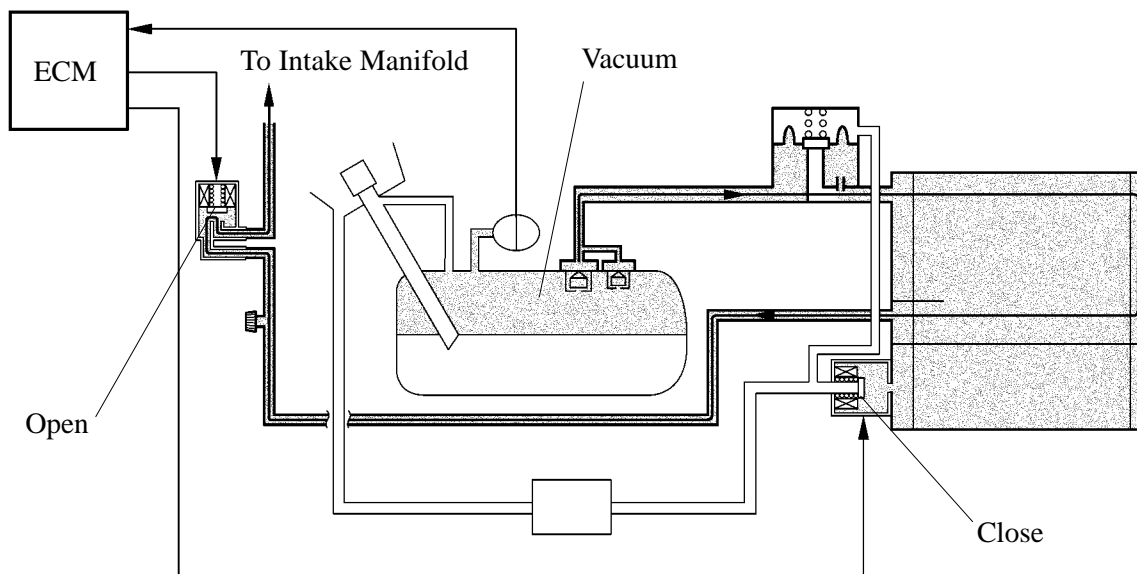
When the initial conditions {low engine temperature (low engine coolant temperature and, engine coolant temperature and intake air temperature being nearly the same) at the engine starting, constant vehicle speed (including idling), and so on.} are met, the ECM introduces a vacuum into the system and monitors the amount of pressure increase in the fuel tank in order to determine if there is any leakage in the system. At the same time, the ECM determines if there is any malfunction in the canister closed valve and the purge valve.

a. Step1

The ECM opens the purge valve and introduces a vacuum into the fuel tank.



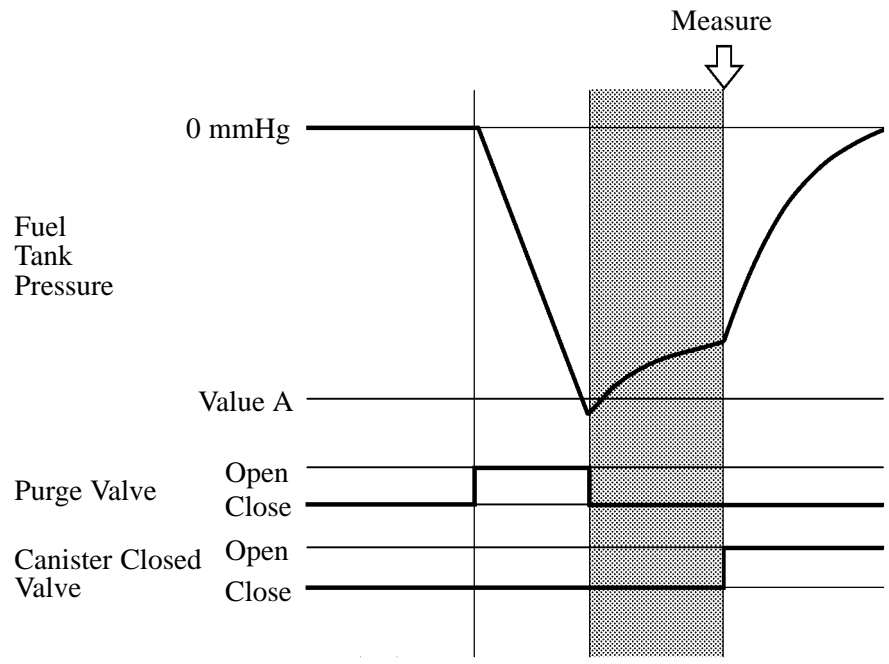
228TU104



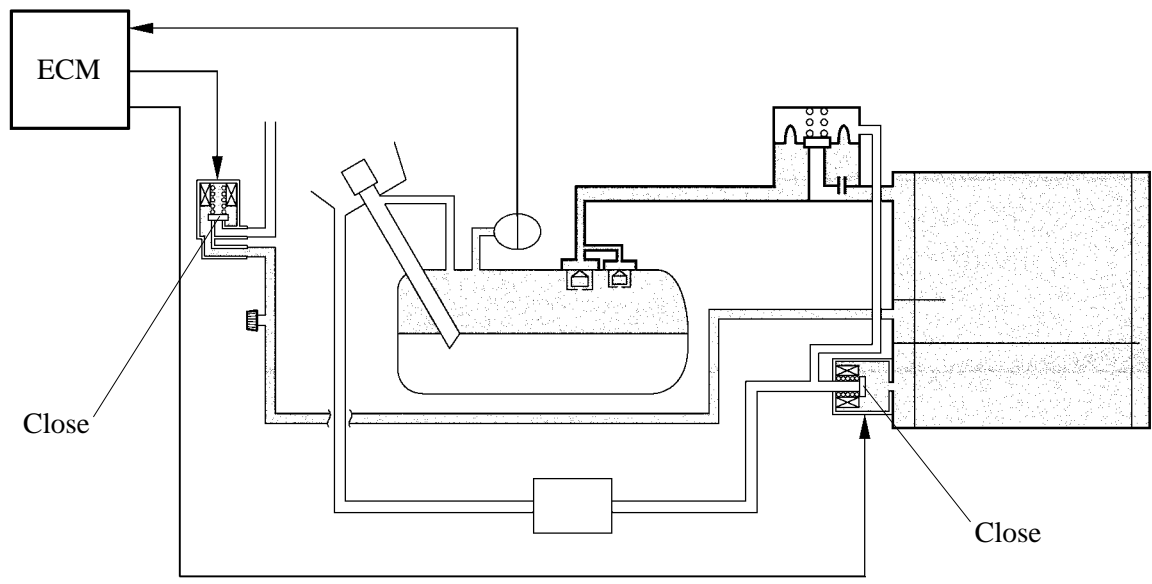
232EG21

b. Step2

When the pressure in the fuel tank decreases below value A, the ECM closes the purge valve again. The ECM measures the amount of pressure increase in the tank.



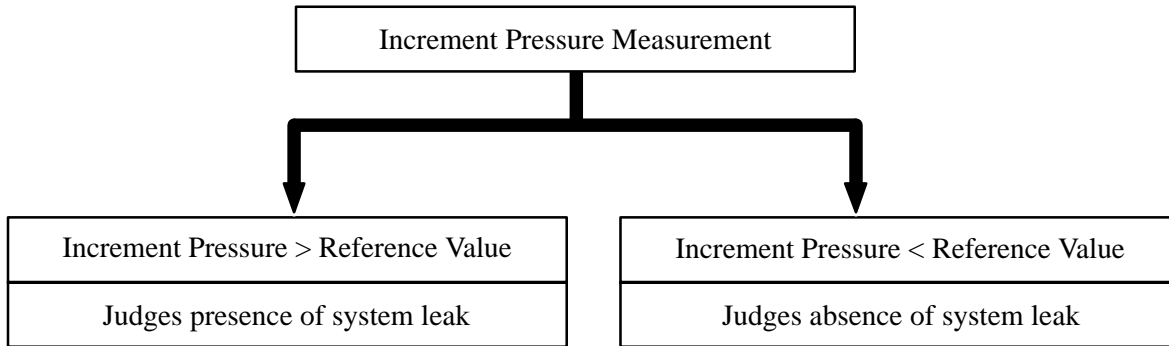
228TU106



232EG22

c. System Leak Judgment

The ECM determines whether there is a leakage in the system by the increment amount of fuel tank pressure at Step2 in the previous page. If the increment amount of the fuel tank pressure is greater than the reference value, the ECM judges that there is a system leak.



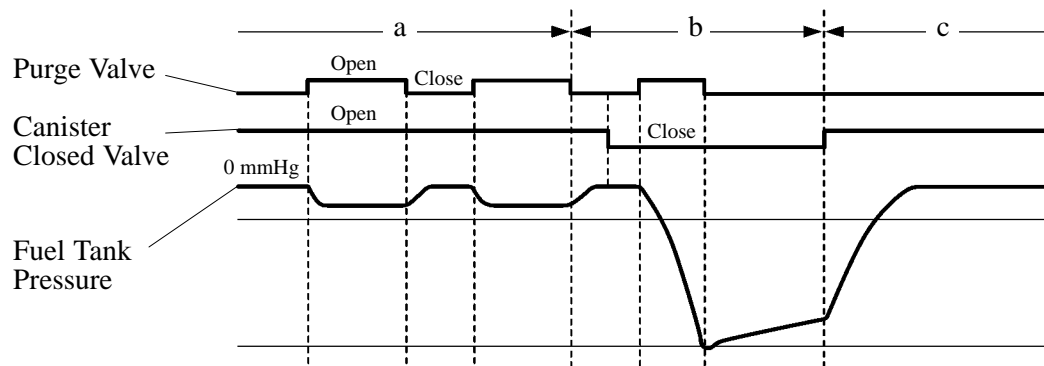
- If the ECM judges that there is no system leak, it ends the system monitoring mode and transfers to the normal system control. (Both the purge valve and canister closed valve are opened.)
- If the ECM determines that there is a system leak, it illuminates the MIL and stores the following DTCs in its memory:

Level of Leak	DTC
Small or medium leak	P0442
Large leak	P0441, P0442 and P0446

d. VSV (Vacuum Switching Valve) Monitoring

i) Normal Condition

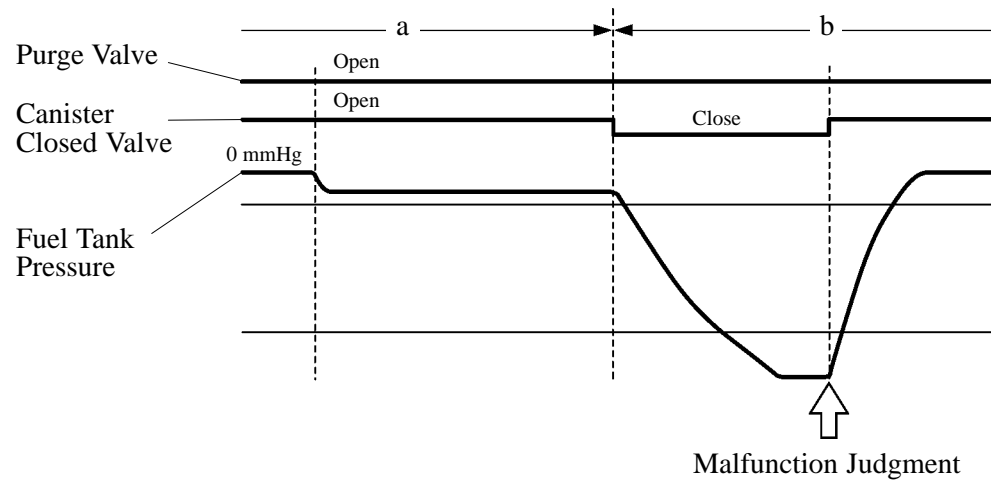
- a. During purging, the ECM opens the purge valve, and this creates a slight vacuum in the fuel tank.
- b. During the system monitoring mode, the ECM opens the purge valve and closes the canister closed valve to introduce a vacuum into the fuel tank.
- c. After the ECM has performed a system leak judgment, it opens the canister closed valve to introduce fresh air into the system. As a result, the atmospheric pressure is reinstated rapidly in the fuel tank.



ii) Purge Valve Open Malfunction

- a. The fuel tank remains in a constant, slight vacuum state regardless of whether the ECM sends an open or close signal to the purge valve.
- b. The pressure in the fuel tank drops rapidly regardless of the close signal that the ECM is sending to the purge valve.

When the ECM detects an open malfunction of the purge valve, it illuminates the MIL and stores the DTC number P0441 in its memory.

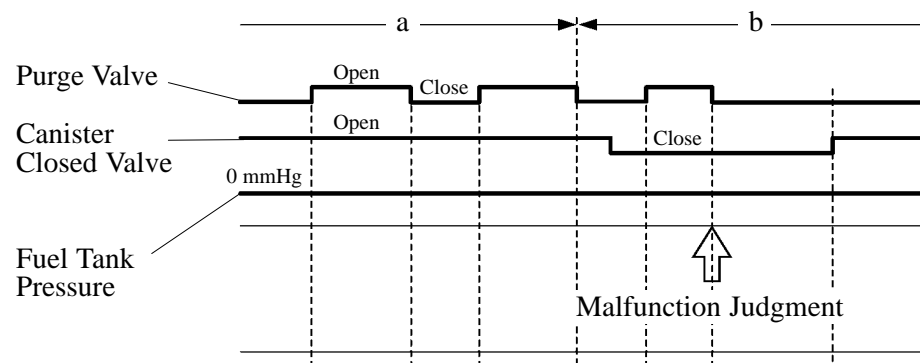


228TU112

iii) Purge Valve Close Malfunction

- a. The pressure in the fuel tank does not change regardless of whether the ECM sends an open or close signal to the purge valve.
- b. Even if the ECM closes the canister closed valve in order to transfer to the system monitoring mode, no vacuum is introduced into the fuel tank.

When the ECM detects a close malfunction of the purge valve, it illuminates the MIL and stores the DTC numbers P0441, P0442, and P0446 in its memory.

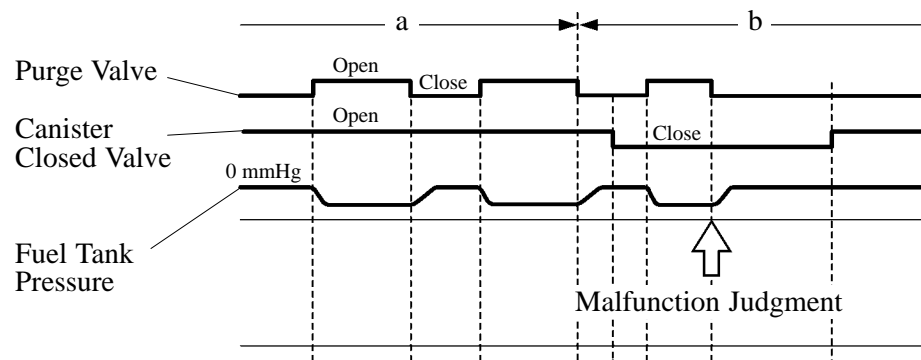


228TU113

iv) Canister Closed Valve Open Malfunction

- a. As the ECM opens the purge valve, a slight vacuum is created in the fuel tank.
- b. Even if the ECM sends a close signal to the canister closed valve in order to transfer to the system monitoring mode, it is not possible to completely introduce a vacuum into the fuel tank.

When the ECM detects an open malfunction of the canister close valve, it illuminates the MIL and stores the DTC numbers P0441, P0442, and P0446 in its memory.

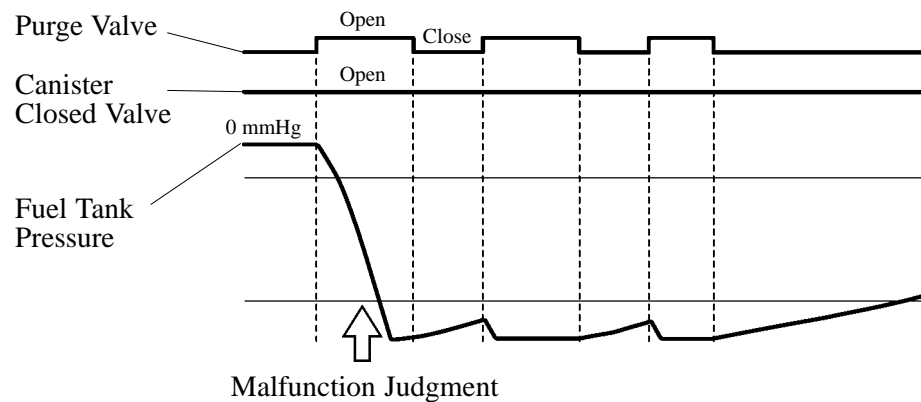


228TU114

v) Canister Closed Valve Close Malfunction

During purging, a large amount of vacuum is introduced into the fuel tank regardless of the open signal that the ECM sends to the canister closed valve. Even if the purge valve closes, the atmospheric pressure is not reinstated in the fuel tank.

When the ECM detects a close malfunction of the canister close valve, it illuminates the MIL and stores the DTC number P0446 in its memory.



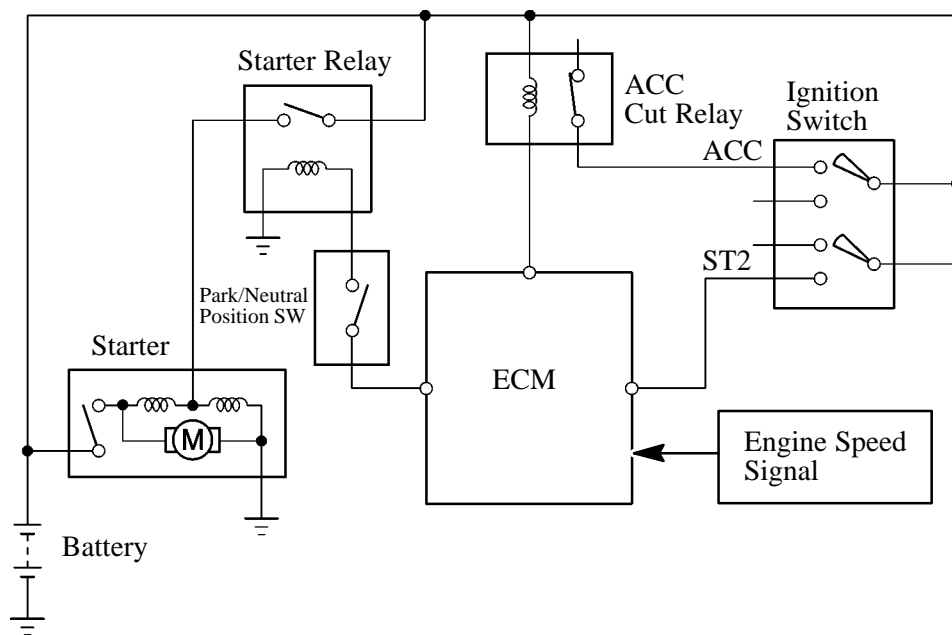
228TU115

9. Cranking Hold Function

General

- The '03 4Runner has adopted cranking hold function. Once the ignition switch is turned to the START position, this control continues to operate the starter until the engine starts, without having to hold the ignition switch in the START position. This prevents starting failures and the engine from being cranked after it has started.
- When the ECM detects a start signal from the ignition switch, this system monitors the engine speed (NE) signal and continues to operate the starter until it has determined that the engine has started. Furthermore, even if the ECM detects a start signal from the ignition switch, it will not operate the starter if it has determined that the engine has already started.

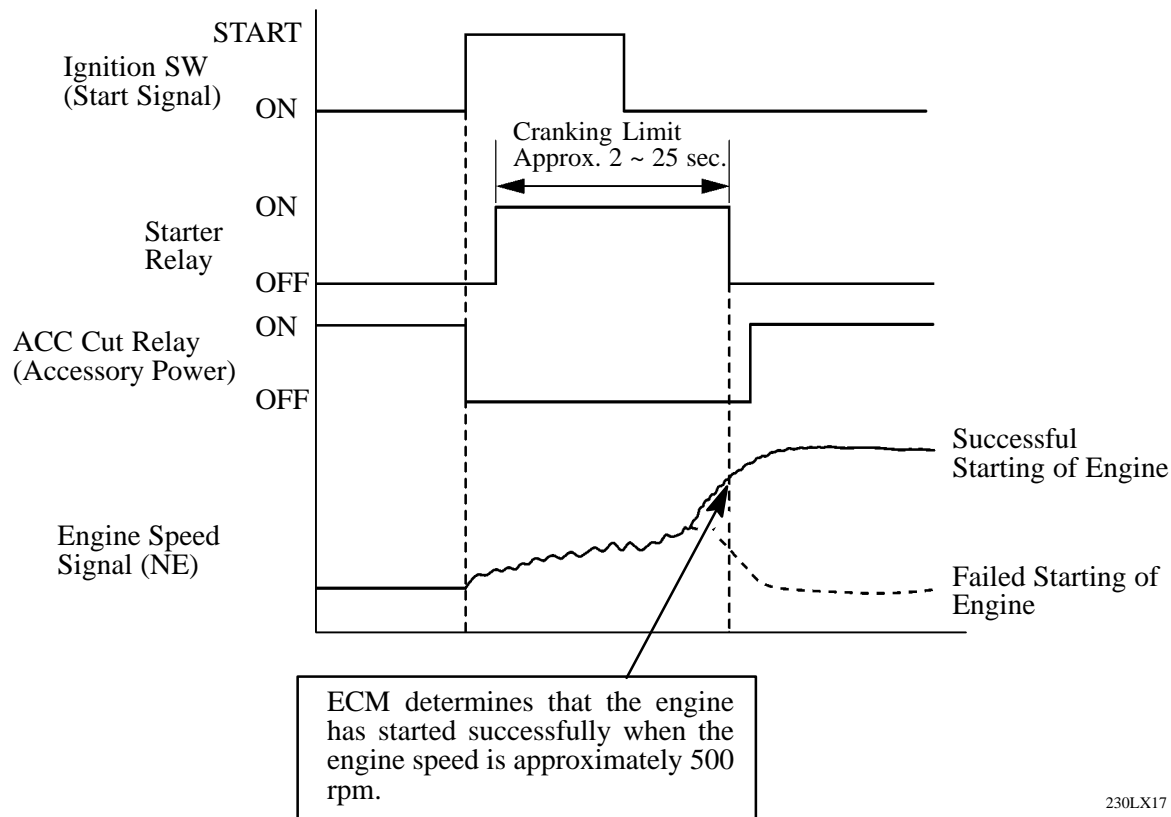
- **System Diagram** ◀



Operation

- As indicated in the timing chart shown below, when the ECM detects a start signal from the ignition switch, it energizes the starter relay to operate the starter. If the engine is already running, the ECM will not energize the starter relay.
- After the starter operates and the engine speed becomes higher than approximately 500 rpm, the ECM determines that the engine has started and stops the operation of the starter.
- If the engine has any failure and will not work, the starter operates as long as its maximum continuous operation time and stops automatically. The maximum continuous operation time is approximately 2 seconds through 25 seconds depending on the engine coolant temperature condition. When the engine coolant temperature is extremely low, it is approximately 25 seconds and when the engine is warmed up sufficiently, it is approximately 2 seconds.
- This system cuts off the current that powers the accessories while the engine is cranking to prevent the accessory illumination from operating intermittently due to the unstable voltage that is associated with the cranking of the engine.

• Timing Chart ◀



10. Diagnosis

- When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver.
- The ECM will also store the DTCs of the malfunctions.
- The DTCs can be accessed the use of the hand-held tester.
- To comply with the OBD-II regulations, all the DTCs (Diagnostic Trouble Codes) have been made to correspond to the SAE controlled codes. Some of the DTCs have been further divided into smaller detection areas than in the past, and new DTCs have been assigned to them. For details, refer to the 2003 4Runner Repair Manual (Pub. No. RM1001U).

Service Tip

To clear the DTC that is stored in the ECM, use a hand-held tester or disconnect the battery terminal or remove the EFI fuse for 1 minute or longer.

11. Fail-Safe

General

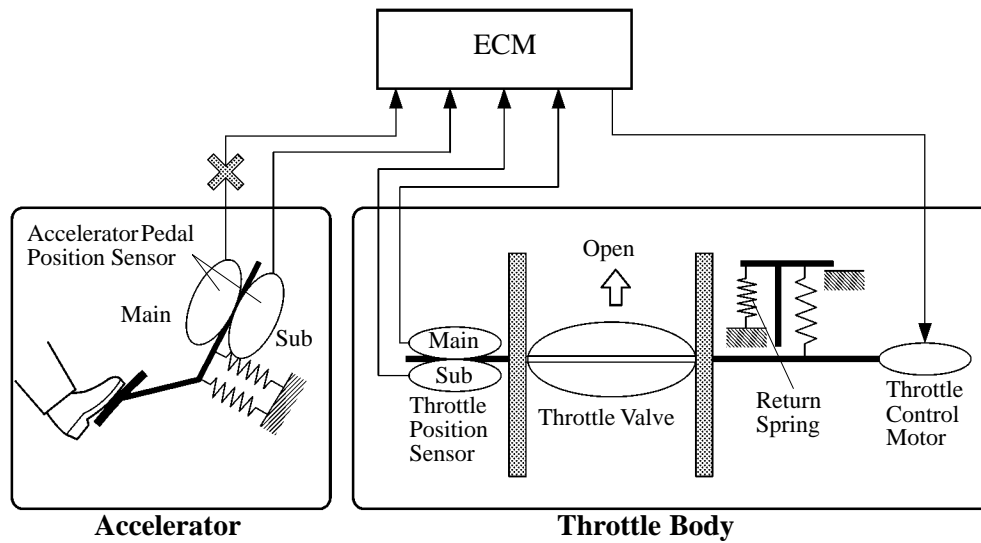
When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.

● Fail-Safe Control List ◀

Location on Malfunction	Description Control
Mass Air Flow Meter	In case of a signal malfunction, the engine could operate poorly or the catalyst could overheat if the engine continues to be controlled with the signals from the sensors. Therefore, the ECM effects control by using the values in the ECM or stops the engine.
Accelerator Pedal Position Sensor (See page EG-52)	In case of a signal malfunction, the ECM calculates the accelerator pedal opening angle that is limited by the dual system sensor value and continues effecting throttle valve control. If both system malfunction, the ECM considers that the accelerator pedal is fully closed.
Throttle Position Sensor (See page EG-53)	In case of a signal malfunction, the ECM cuts off the current to the throttle control motor. The throttle valve returns to the prescribed opening by the force of the return spring. The ECM then adjusts the engine output by controlling the fuel injection and ignition timing in accordance with the accelerator pedal opening angle to enable the vehicle to continue driving.
Engine Coolant Temp. Sensor and Intake Air Temp. Sensor	In case of a signal malfunction, the use of the values from the sensors will make the air-fuel ratio become too rich or too lean, which could causes the engine to stall or to run poorly during cold operation. Therefore, the ECM fixes the air-fuel ratio to the stoichiometric ratio and uses the constant values of 80°C engine coolant temperature and 20°C intake air temperature to perform the calculation.
Knock Sensor	In case of a malfunction in the knock sensor or in the knocking signal system (open or short circuit), the engine could become damaged if the timing is advanced despite the presence of knocking. Therefore, if a malfunction is detected in the knock sensor system, the ECM turns the timing retard correction of the knock sensor into the maximum retard value.
Ignition Coil (with Igniter)	In case of a malfunction in the ignition system, such as an open circuit in the ignition coil, the catalyst could be become overheated due to engine misfire. Therefore, if the (IGF) ignition signal is not input twice or more in a row, the ECM determines that a malfunction occurred in the ignition system and stops only the injection of fuel into the cylinder with the malfunction.

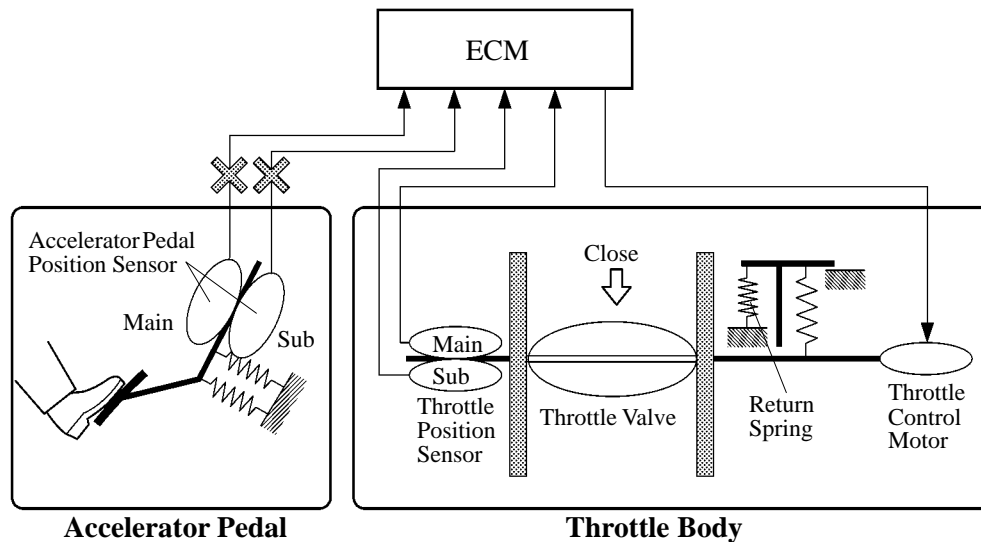
Fail-Safe of Accelerator Pedal Position Sensor

- The accelerator pedal position sensor comprises two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the ECM detects the abnormal signal voltage difference between these two sensor circuit and switches to the limp mode. In the limp mode, the remaining circuit is used to calculate the accelerator pedal opening, in order to operate the vehicle under limp mode control.



199EG45

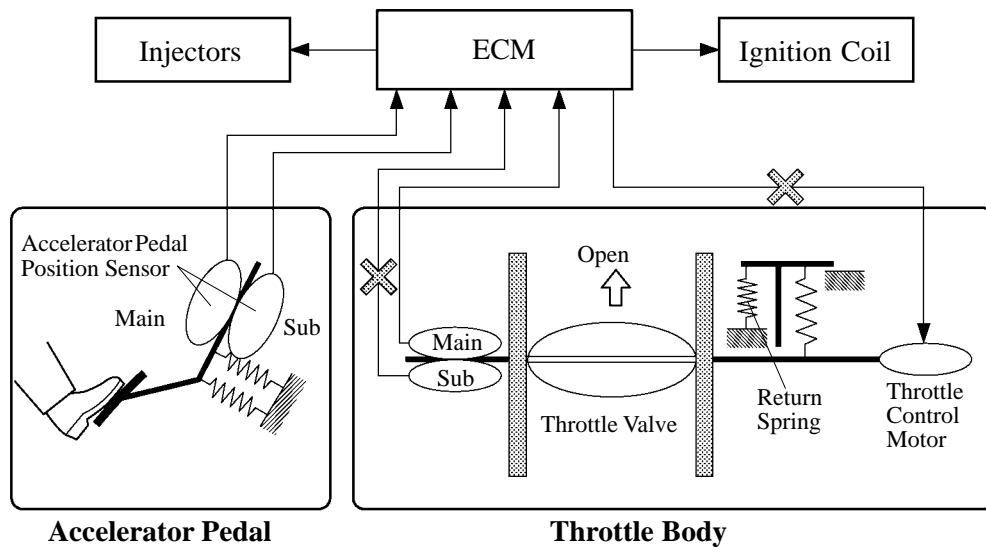
- If both systems malfunction, the ECM detects the abnormal signal voltage between these two sensor circuits and regards that the opening angle of the accelerator pedal is fully opened and then continues the throttle control. At this time, the vehicle can be driven within its idling range.



199EG46

Fail-Safe of Throttle Position Sensor

- The throttle position sensor comprises two (main, sub) sensor circuits. If a malfunction occurs in either one of the sensor circuits, the ECM detects the abnormal signal voltage difference between these two sensor circuits, cuts off the current to the throttle control motor, and switches to the limp mode. Then, the force of the return spring causes the throttle valve to return and stay at the prescribed opening. At this time, the vehicle can be driven in the limp mode while the engine output is regulated through the control of the fuel injection and ignition timing in accordance with the accelerator opening.
- The same control as above is effected if the ECM detects a malfunction in the throttle control motor system.



● FEATURES OF 2UZ-FE ENGINE

The 2UZ-FE engine has been able to achieve the following performance through the adoption of the items listed below.

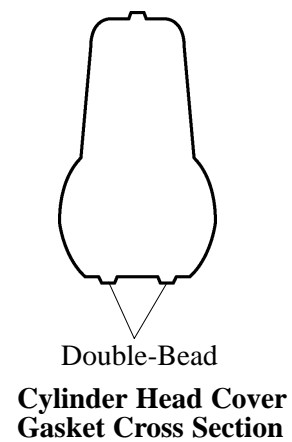
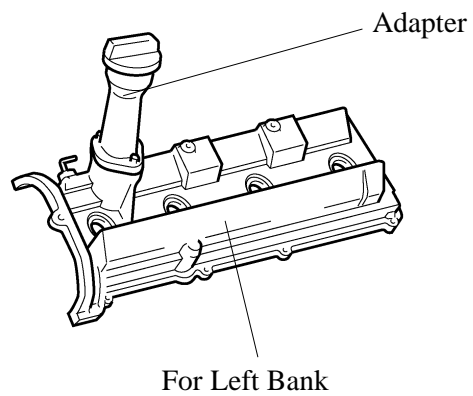
- (1) High performance and fuel economy
- (2) Low noise and vibration
- (3) Lightweight and compact design
- (4) Good serviceability
- (5) Clean emission

Item	(1)	(2)	(3)	(4)	(5)
An upright intake port is used to improve the intake efficiency.	◀				
A taper squish configuration is used to improve the combustion efficiency.	◀				◀
A steel laminate type cylinder head gasket is used to ensure its reliability.				◀	
An aluminum oil pan that is integrated with stiffeners is used to reduce noise and vibration.		◀			
The skirt portion of the piston is applied with resin coating to reduce friction.	◀	◀			
Inner shim type valve lifters are used.	◀		◀		
Large-diameter intake and exhaust valves are used to reduce the intake and exhaust resistance.	◀				◀
A multi-plate aluminum type automatic transmission oil cooler is used in the radiator lower tank.	◀				
A long port intake manifold is used to improve the engine's torque in the low-to-mid speed range.	◀				
4-hole type fuel injectors are used to improve the atomization of fuel.	◀				◀
The DIS (Direct Ignition System) makes ignition timing adjustment unnecessary.	◀			◀	◀
Segment Conductor type generator has been adopted.	◀		◀		
Cranking hold function has been adopted.				◀	
ETCS-i has been adopted to achieve excellent controllability and comfort of the vehicle.	◀				
The link-less type throttle body has been adopted.			◀	◀	
The no-contact sensor has been adopted in the throttle position sensor.				◀	
The no-contact sensor has been adopted in the accelerator pedal position sensor.				◀	
A carbon filter, which adsorbs the HC that accumulates in the intake system when the engine is stopped, has been adopted in the air cleaner cap.					◀
A service port has been provided for inspecting the evaporating emission control system.				◀	
The vacuum type monitor has been adopted to detect leaks in the evaporative emission control system.				◀	◀

◀ENGINE PROPER

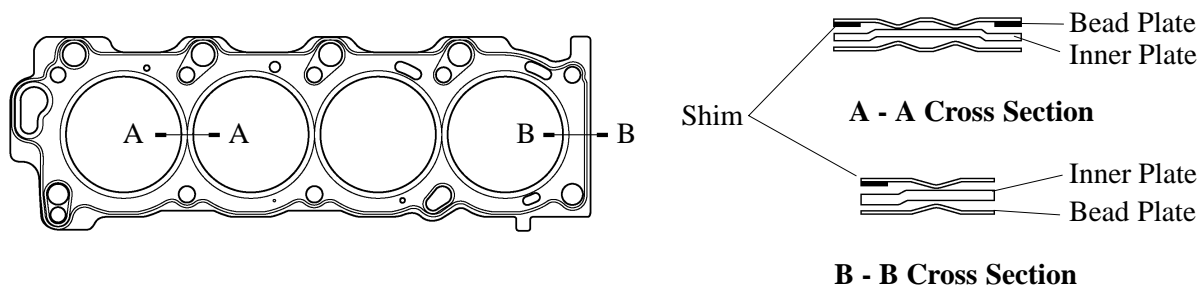
1. Cylinder Head Cover

- Lightweight yet high-strength aluminum head covers are used.
- An adapter has been provided on the left bank cylinder head cover to improve the serviceability when filling the engine oil.
- The cylinder head cover gaskets are used a double-bead cross-sectional construction to improve their reliability.



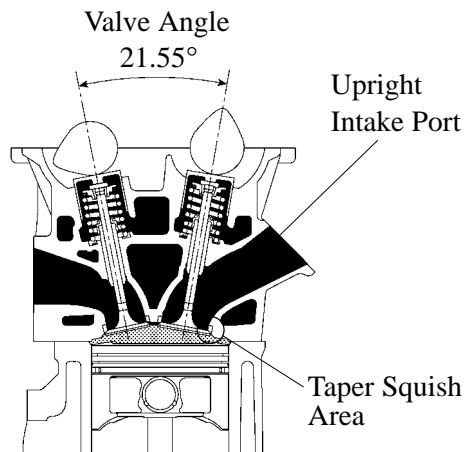
2. Cylinder Head Gasket

3-layer cylinder head gaskets with shims are used to ensure reliability and to minimize the deformation of the cylinder bore. This resulted in improved fuel economy and reduced the consumption rate of engine oil and the emission of exhaust gases.

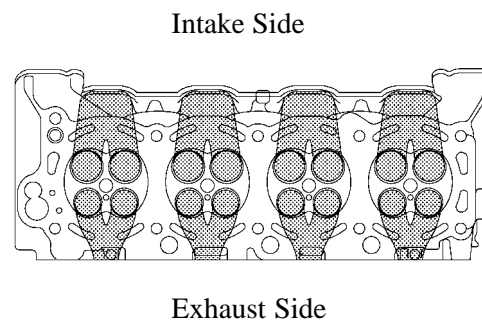


3. Cylinder Head

- The cylinder head, which is made of aluminum, is used a pentroof-type combustion chamber. The spark plug has been located in the center of the combustion chamber in order to improve the engine's anti-knocking performance.
- The angle of the intake and exhaust valves is narrowed and set at 21.55° to permit a compact cylinder head.
- Upright intake ports are used to improve the intake efficiency.
- A taper squish combustion chamber is used to improve anti-knocking performance and intake efficiency. In addition, engine performance and fuel economy have been improved.
- Plastic region tightening bolts are used for the cylinder head for good axial tension.



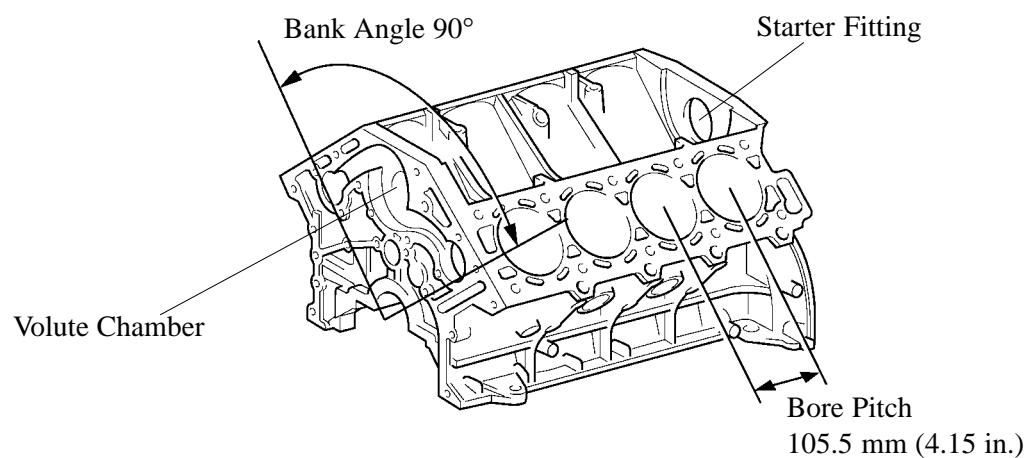
156EG34



156EG35

4. Cylinder Block

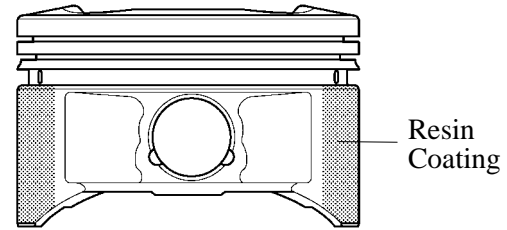
- The cylinder block is made of cast iron.
- The cylinder block has a bank angle of 90° , a bank offset of 21 mm (0.827 in.) and a bore pitch of 105.5 mm (4.15 in.), resulting in a compact block in its length and width even for its displacement.
- Part of the volute chamber of the water pump is incorporated into the cylinder block to shorten the engine length.
- Installation bosses for the two knock sensors are located on the inner side of left and right banks.
- Plastic region tightening bolts are used for the crankshaft bearing caps.
- The starter is located inside the V-bank.



196EG20

5. Piston

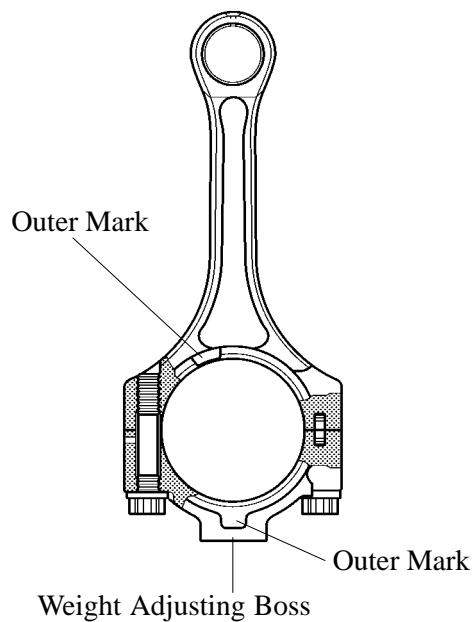
- The piston is made of aluminum alloy.
- The piston head portion has adopted a taper squish to improve the fuel combustion efficiency.
- The piston ring grooves have been treated with anodic treatment to improve the piston's wear resistance.
- Full floating type piston pins are used.
- The skirt portion of the piston has been applied with resin coating to reduce friction.



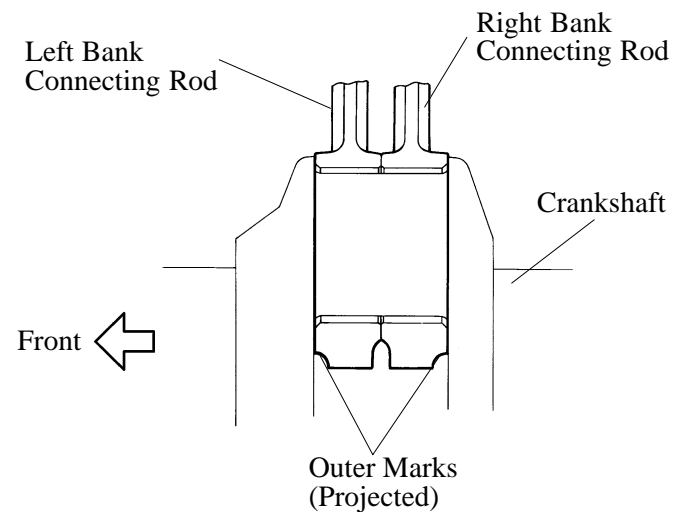
156EG02

6. Connecting Rod

- The sintered and forged connecting rod is very rigid and has little weight fluctuation.
- A weight-adjusting boss is provided at the big end to reduce fluctuation of weight and balance the engine assembly.
- The connecting rod cap is held by plastic region tightening bolts.
- The connecting rods for the right and left banks are placed in opposite directions with the outer marks facing the crankshaft.
- The connecting rod bearing is made of aluminum alloy.



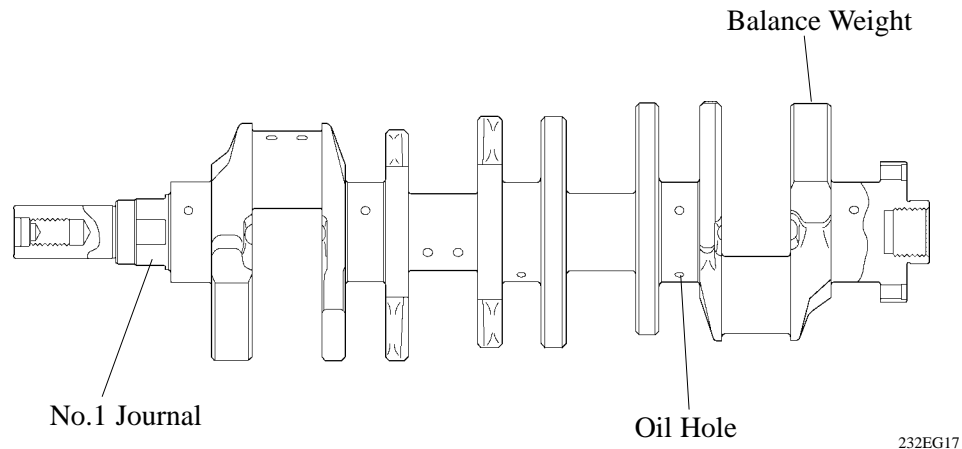
156EG03



156EG09

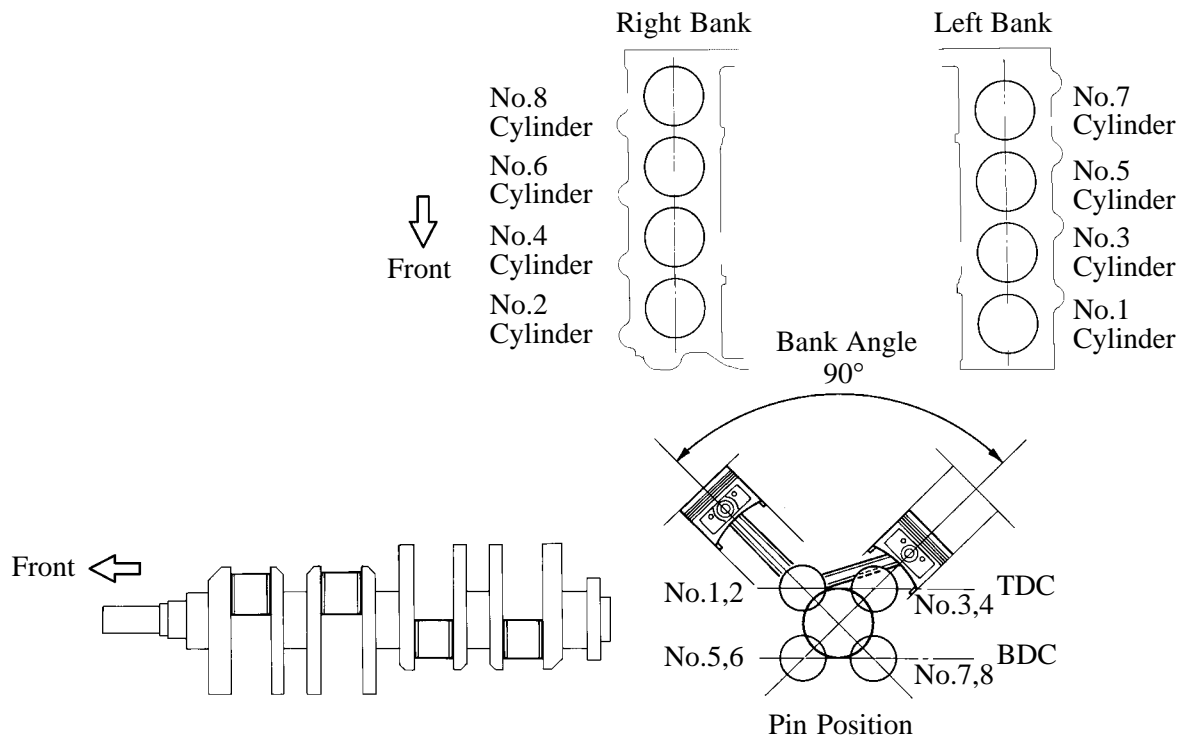
7. Crankshaft

- A crankshaft made of steel, which excels, in rigidity and wear resistance, is used.
- The crankshaft has 5 journals and 8 counter weights.
- The crankshaft bearing is made of aluminum alloy.



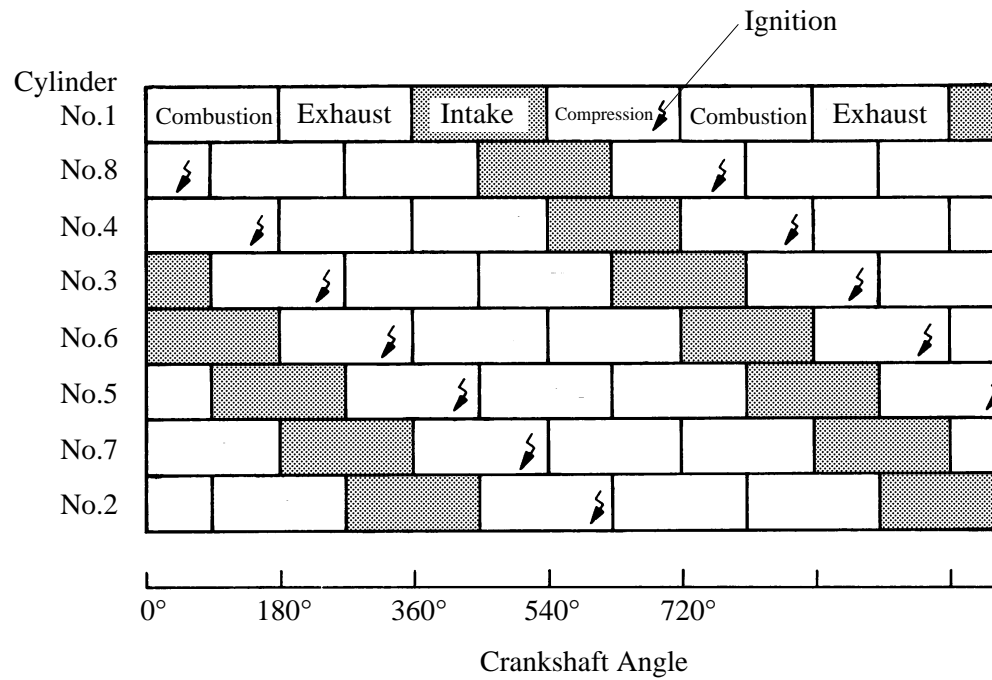
232EG17

NOTE: The positions of the crankshaft pins and pistons are illustrated below. The numbers of the crankshaft and the pistons are shown on the right.



156EG10

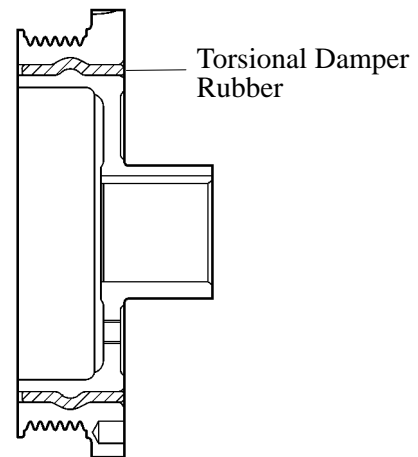
- Crankshaft angles and engine strokes (intake, compression, combustion and exhaust) are shown in the table below. The firing order is 1 - 8 - 4 - 3 - 6 - 5 - 7 - 2.



156EG11

8. Crankshaft Pulley

The rigidity of the torsional damper rubber has been optimized to reduce noise.

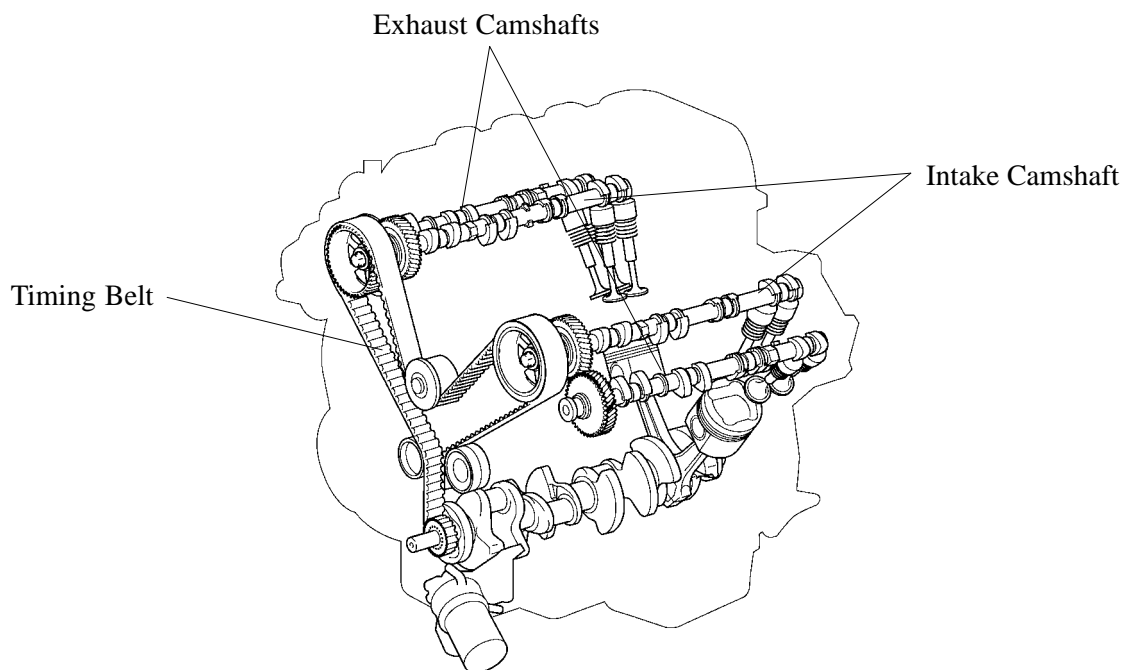


232EG26

◀ VALVE MECHANISM

1. General

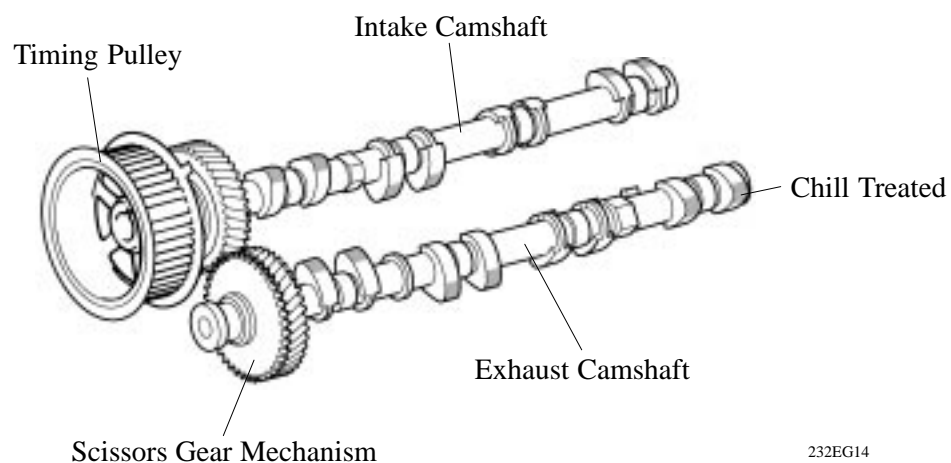
- Each cylinder has 2 intake valves and 2 exhaust valves. Intake and exhaust efficiency is increased by means of the larger total port areas.
- The valves are directly opened and closed by 4 camshafts.
- The intake camshafts are driven by a timing belt, while the exhaust camshafts are driven through gears on the intake camshafts.



232EG27

2. Camshaft

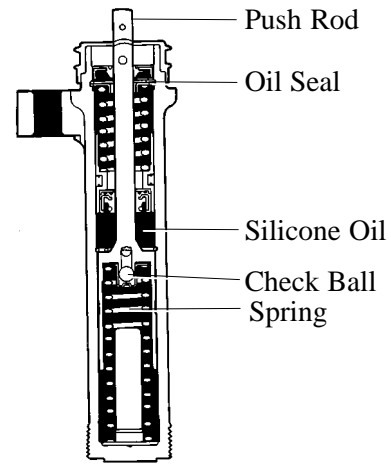
- The camshafts are made of cast iron alloy. The cam nose has been chill treated to increase its abrasion resistance.
- The exhaust camshafts are driven by gears on the intake camshafts. The scissors gear mechanism is used on the exhaust camshaft to control backlash and suppress gear noise.



232EG14

3. Automatic Tensioner

The automatic tensioner is made up of a spring and oil damper, and maintains proper timing belt tension at all time. The automatic tensioner suppresses noise generated by the timing belt.

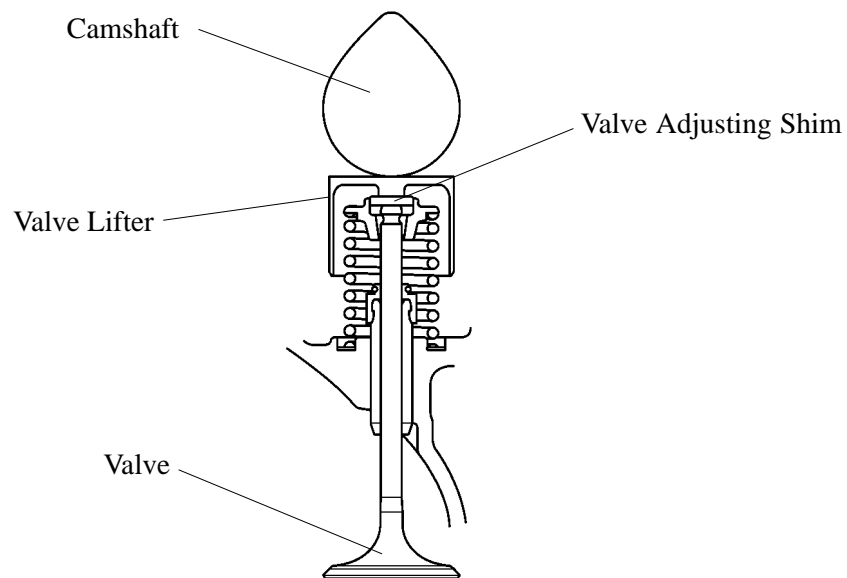


Automatic Tensioner

156EG12

4. Intake and Exhaust Valve and Valve Lifter

- Intake and exhaust valves with large-diameter valve face have been adopted to improve the intake and exhaust efficiency. In addition, narrower valve stems have been adopted to reduce the intake and exhaust resistance and for weight reduction.
- Inner shim type valve adjusting shims, which allow a greater amount of valve lift, are used.
- Valve lifters made of steel are used.

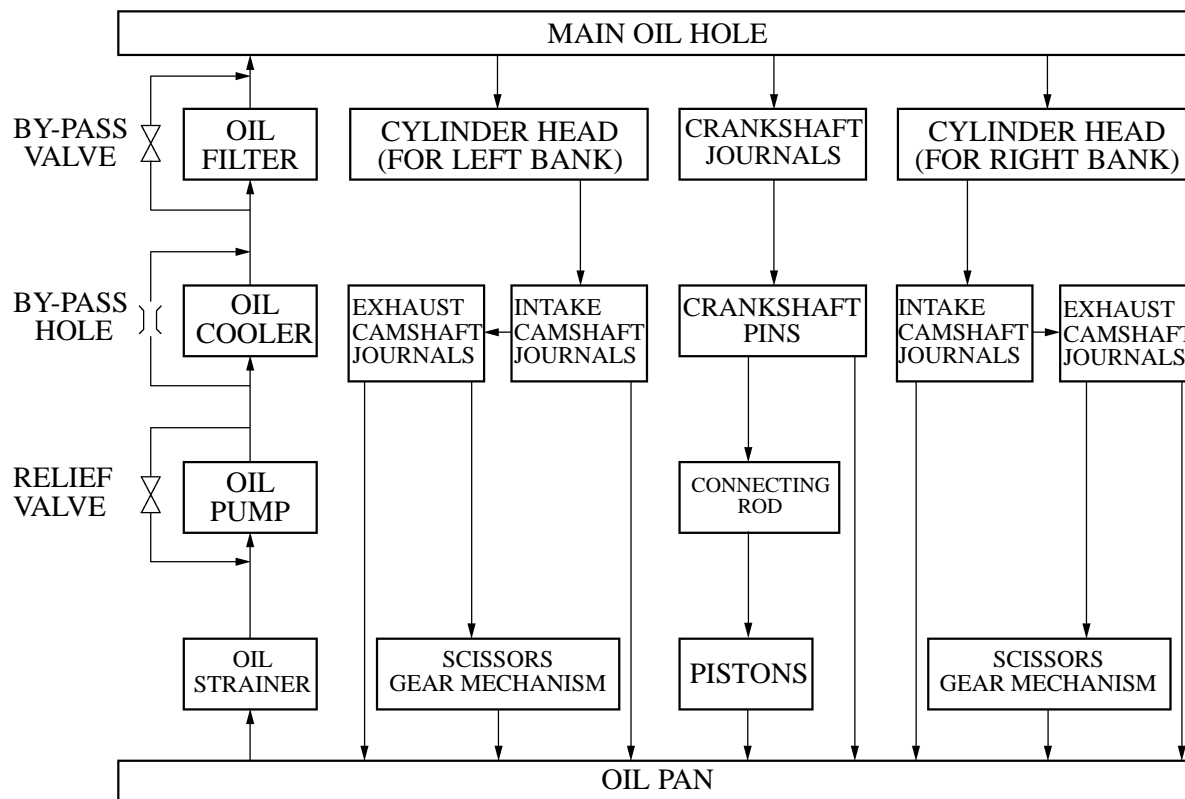
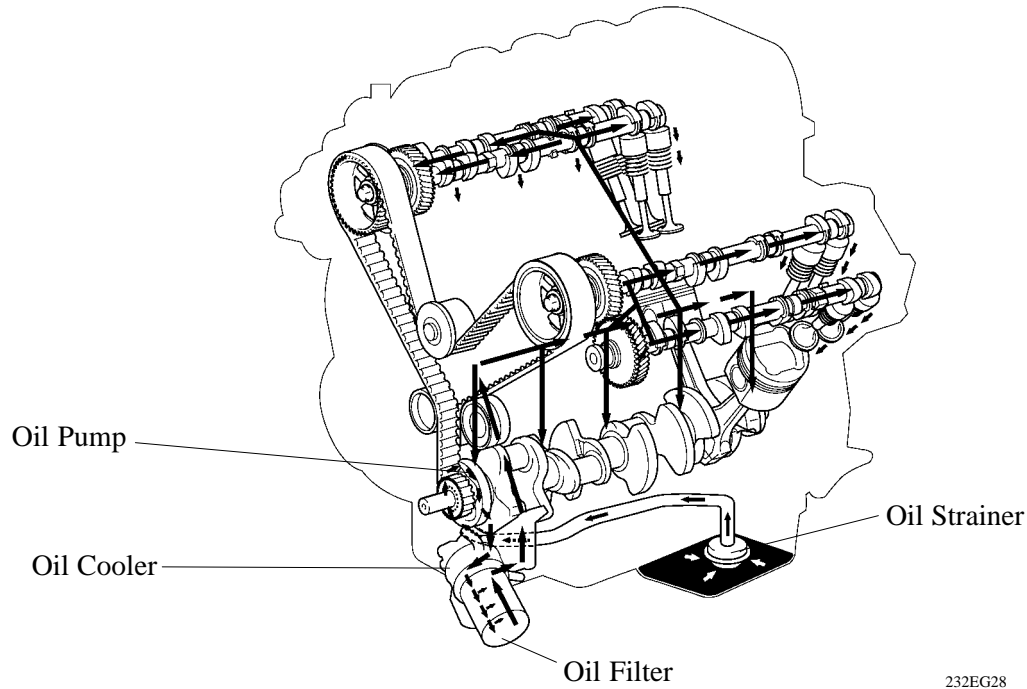


188EG63

◀ LUBRICATION SYSTEM

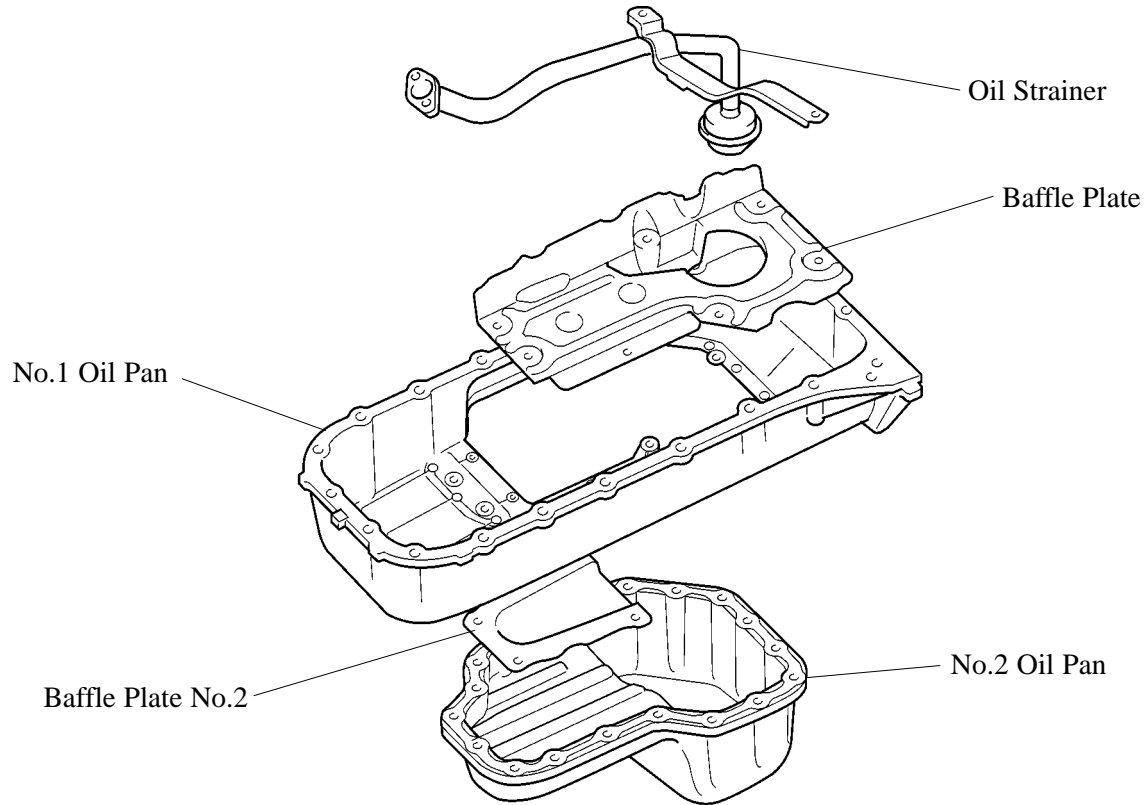
1. General

- The lubrication circuit is fully pressurized and all oil passes through an oil filter.
- A trochoid gear type oil pump is directly driven by crankshaft.
- The water-cooled type engine oil cooler is used to lower the oil temperature.



2. Oil Pan

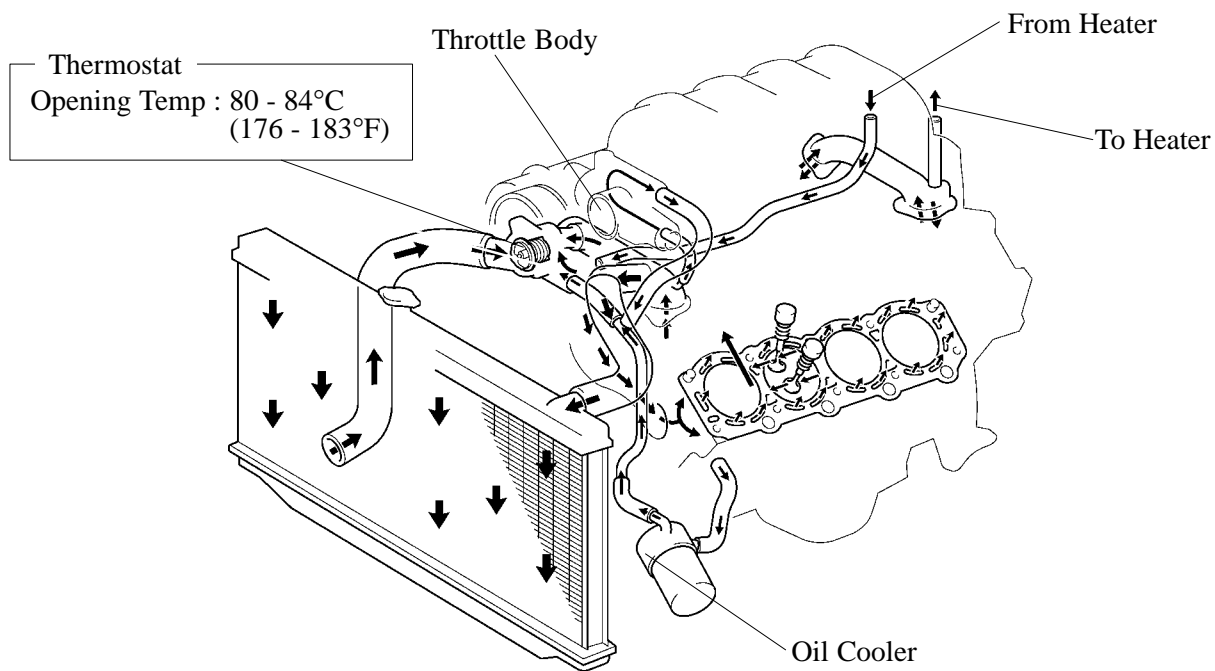
- The oil pan is made up of 2 pieces. The No.1 oil pan is made of aluminum alloy and the No.2 oil pan is made of steel.
- The No.1 oil pan is secured to the cylinder block and the torque converter housing to increase rigidity.



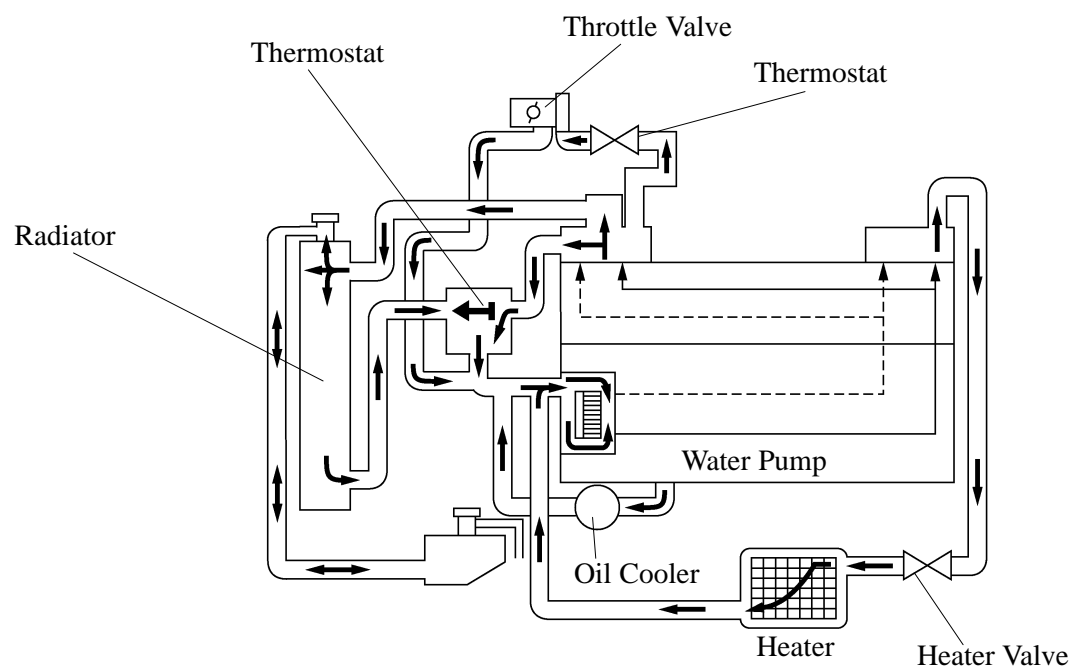
◀ COOLING SYSTEM

1. General

- The cooling system is a pressurized, forced-circulation type.
- A thermostat with a bypass valve is located on the water inlet housing to maintain suitable temperature distribution in the cooling system.
- An aluminum radiator core is used for weight reduction.



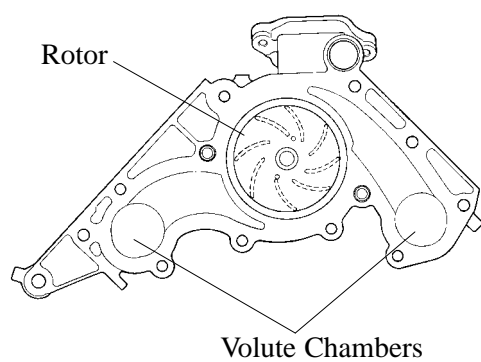
156EG42



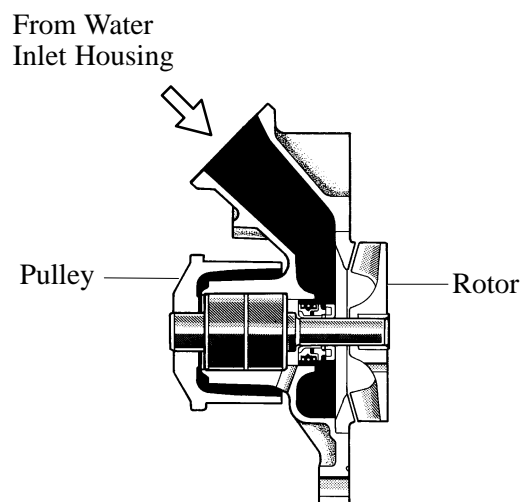
156EG43

2. Water Pump

- The water pump has two volute chambers, and circulates coolant uniformly to the left and right banks of the cylinder block.
- The water pump is driven by the back of the timing belt.
- The rotor is made of resin.



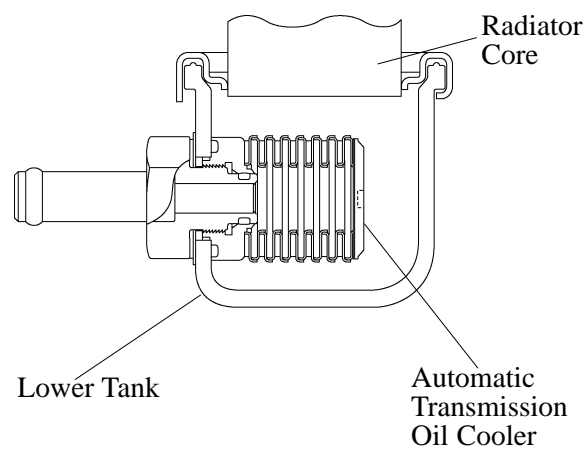
156EG13



156EG14

3. Radiator

- An aluminum radiator core is used for weight reduction.
- A multi-plate aluminum type automatic transmission oil cooler is used in the radiator lower tank.



232EG02

4. Coupling Fan

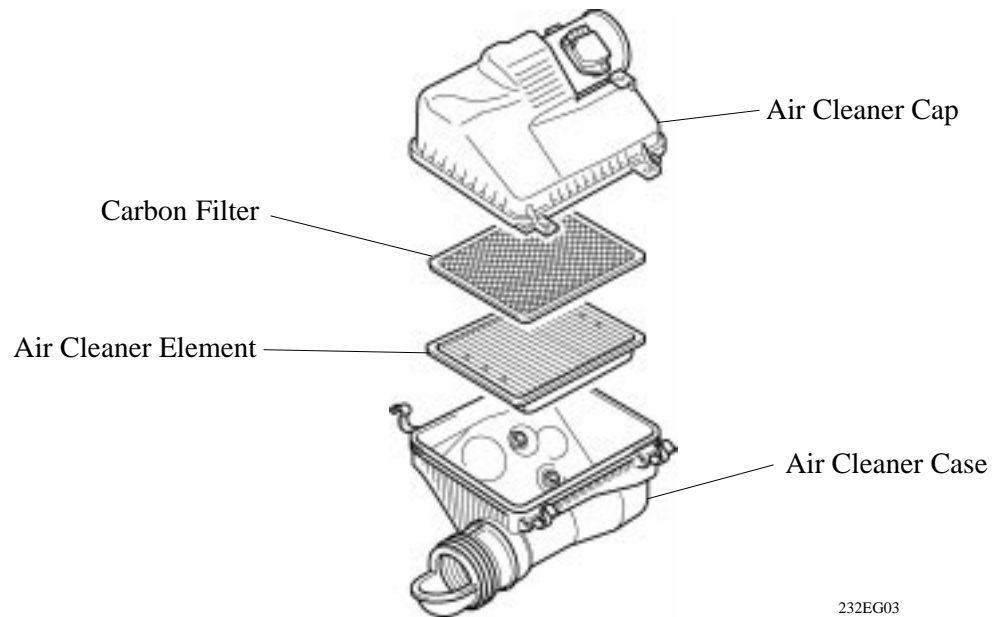
A 2-stage temperature-controlled coupling fan is used. It rotates at lower speeds when the engine is started to minimize the fan noise.

◀ INTAKE AND EXHAUST SYSTEM

1. Air Cleaner

A carbon filter, which adsorbs the HC that accumulates in the intake system when the engine is stopped, has been adopted in the air cleaner cap in order to reduce evaporative emissions.

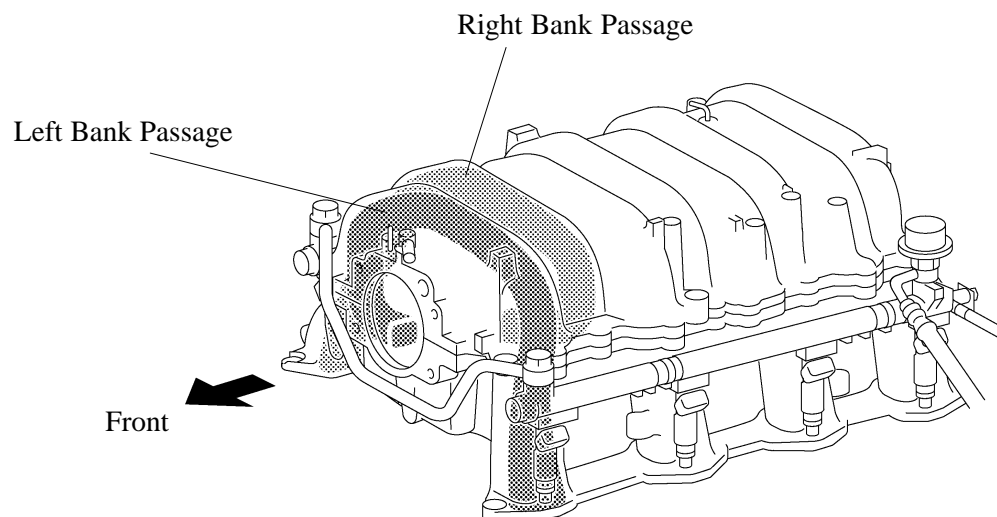
This filter is maintenance-free.



232EG03

2. Intake Manifold

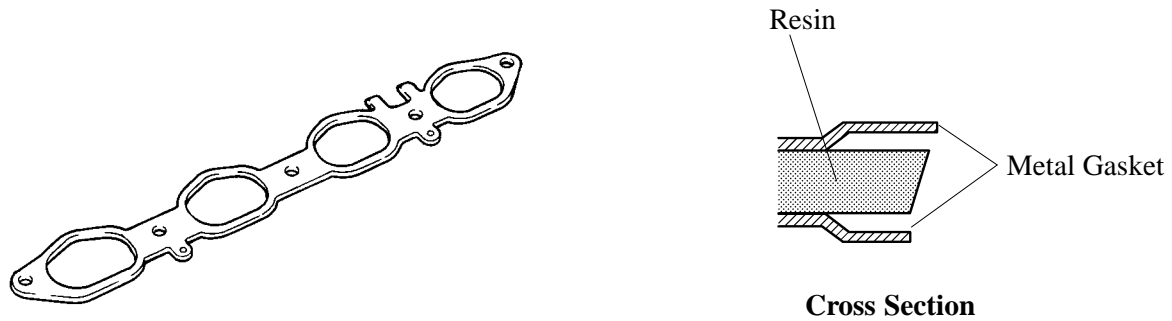
The low-to-mid speed range torque has been improved by increasing the length of the intake manifold port.



156EG44

3. Intake Manifold Gasket

- A heat-barrier gasket is used for use between the cylinder head and the intake manifold. This gasket, which restrains the heat transfer from the cylinder head to the intake manifold, and keeps the intake air temperature lower to improve the volumetric efficiency.
- The construction of the gasket consists of resin that is sandwiched between metal gaskets.



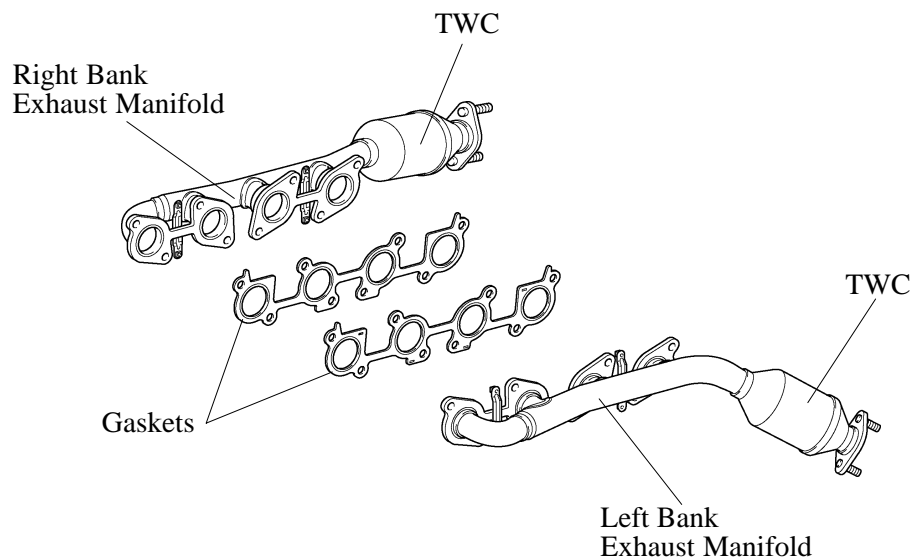
151EG69

144EG04

4. Exhaust Manifold

General

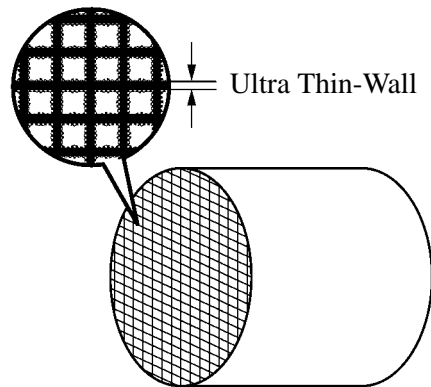
- The exhaust manifolds are made of stainless steel for weight reduction.
- An ultra thin-wall, high-cell density, ceramic type TWC (Three-Way Catalytic Converter) has been adopted. This TWC is incorporated on each of the right and left banks.



232EG04

Three-Way Catalytic Converter

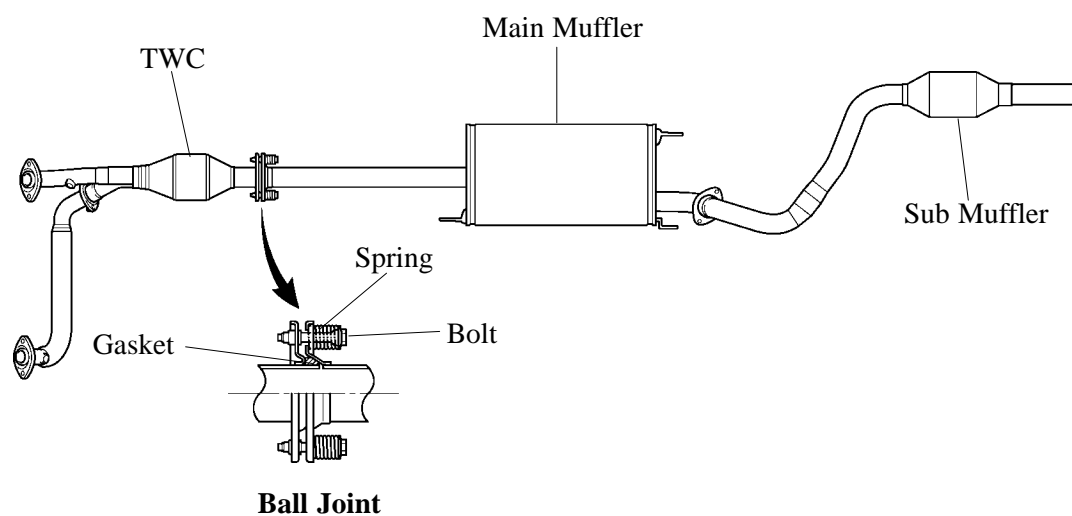
This TWC enables to improve exhaust emissions by optimizing the cells density and the wall thickness.



198EG06

5. Exhaust Pipe

- The exhaust pipe is made of stainless steel for improved rust resistance.
- A ball joint is used to join the exhaust front pipe and exhaust center pipe. As a result, a simple construction and improved reliability have been achieved.
- A thin-wall, ceramic type TWC has been adopted.

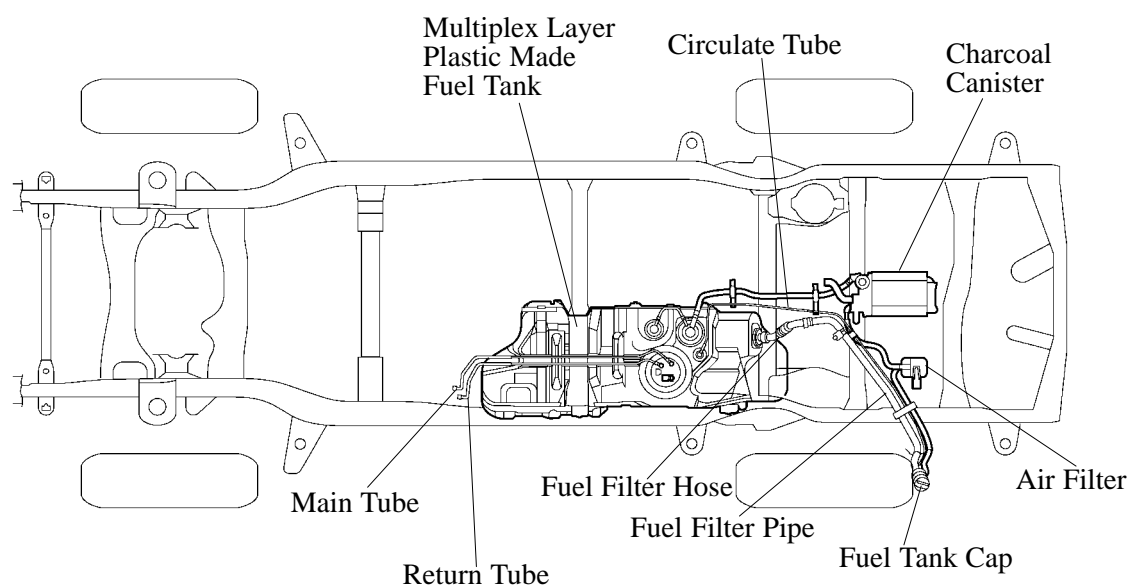


232EG05

◀ FUEL SYSTEM

1. General

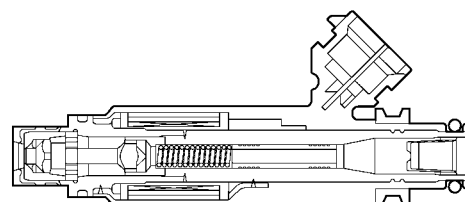
- A compact 4-hole type fuel injector has been adopted to improve the atomization of fuel.
- A compact fuel pump in which a fuel filter is integrated in the fuel pump assembly has been adopted.
- A quick connector has been adopted to connect the fuel pipe with the fuel hose to improve serviceability.
- On the '03 model, a portion of the construction of the evaporative emission control system has been changed in order to comply with the LEV-II (Low Emission Vehicle-II) evaporative emission regulations. For details, refer to the Evaporative Emission Control System section on page EG-39. Along with this change, the following items have been primarily adopted:
 - A multiplex layer plastic made fuel tank has been adopted.
 - A stainless steel made fuel filler pipe has been adopted.
 - A multiplex layer plastic made tube and hose has been adopted.
 - An air filter has been adopted in the fresh air line.
 - A tether has been provided on the fuel tank cap to prevent the cap from being lost, which results in preventing the leakage of fuel or the evaporative gas.
- The quick-turn fuel tank cap has been adopted to improve usability.



232EG06

2. Fuel Injector

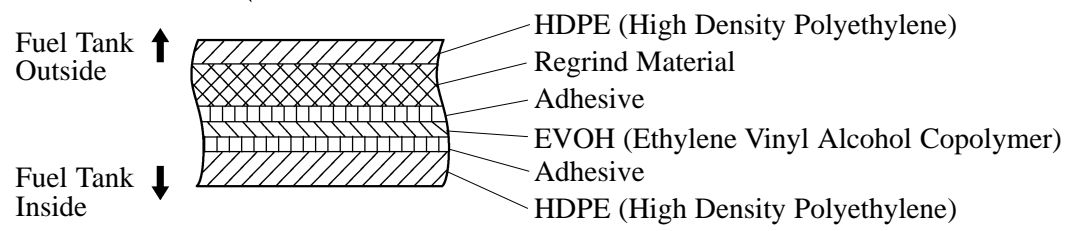
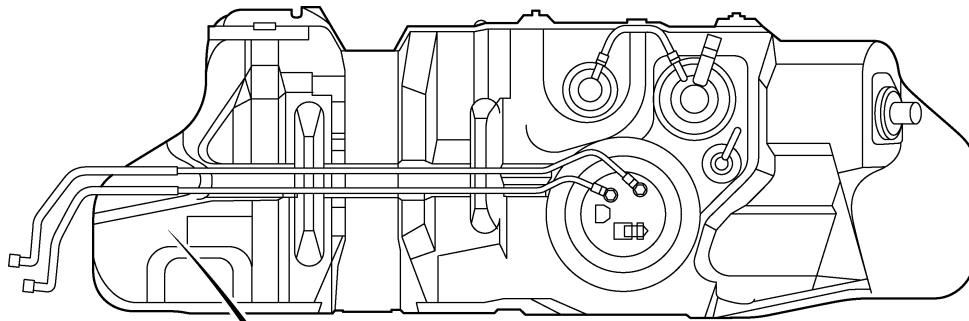
A compact 4-hole type fuel injector is used to improve the atomization of fuel.



156EG15

3. Fuel Tank

A multiplex layered plastic fuel tank has been adopted. This fuel tank consists of six layers of four types of materials.

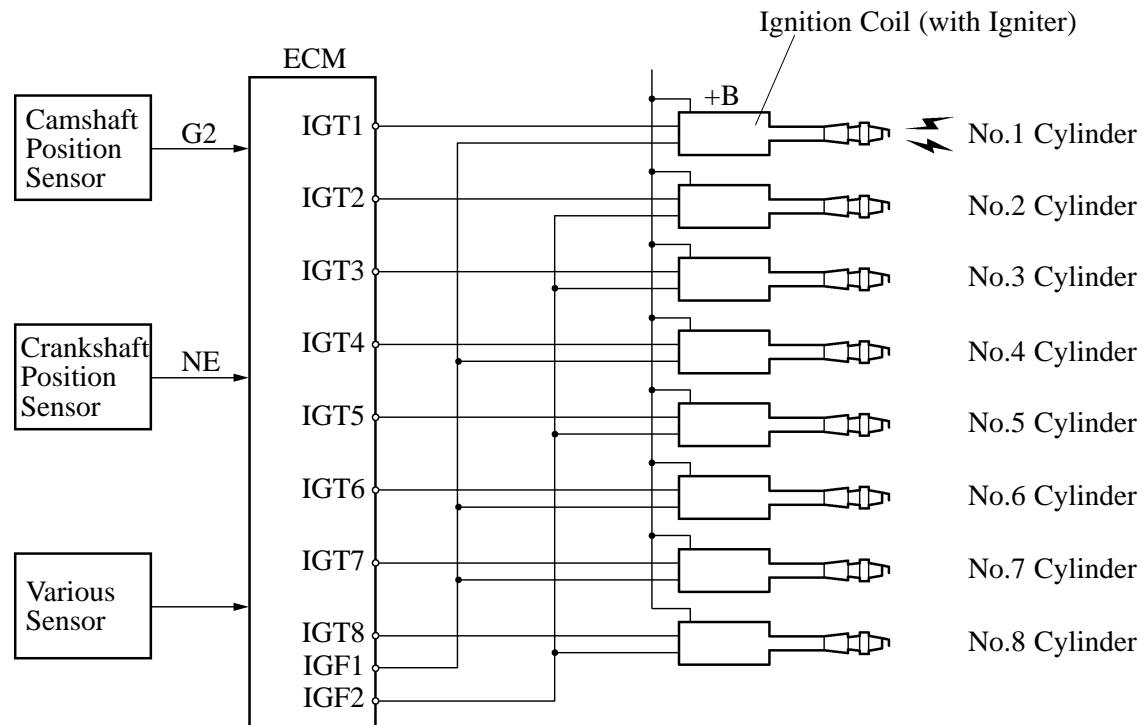


● IGNITION SYSTEM

1. General

A DIS (Direct Ignition System) is used in the 2UZ-FE engine. The DIS improves the ignition timing accuracy, reduces high-voltage loss, and enhances the overall reliability of the ignition system by eliminating the distributor.

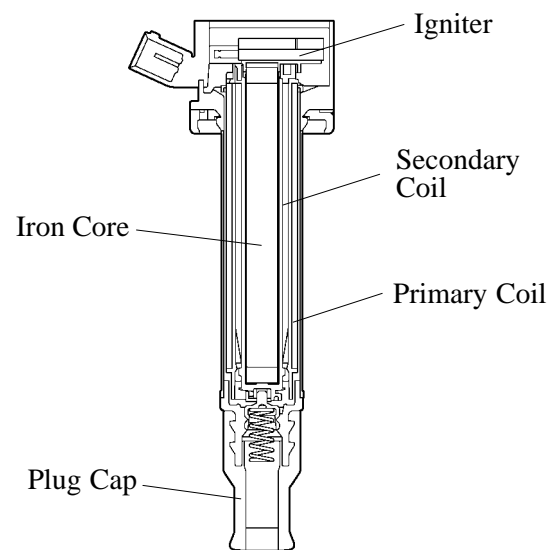
The DIS in 2UZ-FE engine is an independent ignition system which has one ignition coil for each cylinder.



151EG05

2. Ignition Coil

The DIS provides 8 ignition coils, one for each cylinder. The spark plug caps, which provide contact to spark plugs, are integrated with an ignition coil. Also, an igniter is enclosed to simplify the system.



Ignition Coil Cross Section

156EG16

◦ **5VZ-FE AND 2UZ-FE ENGINES**

The TOYOTA Genuine Super Long Life Coolant (SLLC) has been adapted. As a result, the maintenance interval has been extended.

● **Specifications ◀**

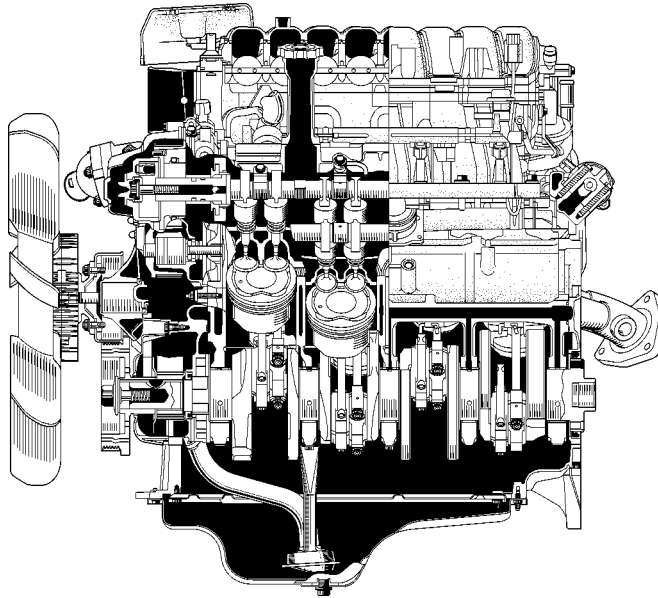
Model				'04 Toyota Tundra	'03 Toyota Tundra
Engine Coolant	Capacity Liter (US qts, Imp. qts)	5VZ-FE	A/T	9.9 (10.5, 8.7)	←
			M/T	10.0 (10.6, 8.8)	←
		2UZ-FE		11.6 (12.3,10.2)	←
	Type			TOYOTA Genuine SLLC	TOYOTA Genuine LLC
	Color			Pink	Red
	Maintenance Intervals		First time		100,000 mile (160,000 km)
Subsequent			Every 50,000 mile (80,000 km)		
Thermostat	Opening Temperature		•C (•F)	80 - 84 (176 - 183)	←

- SLLC is pre-mixed (50% coolant and 50% distilled water), so no dilution is needed when adding or replacing SLLC in the vehicle.
- If LLC is mixed with SLLC, the interval for LLC (every 30,000 mile (U.S.A.), 32,000 km (CANADA) or 24 months) should be used.
- You can also apply the new maintenance interval (every 50,000 mile (80,000 km)) to vehicles initially filled with LLC (red-colored), if you use SLLC (pink-colored) for the coolant change.

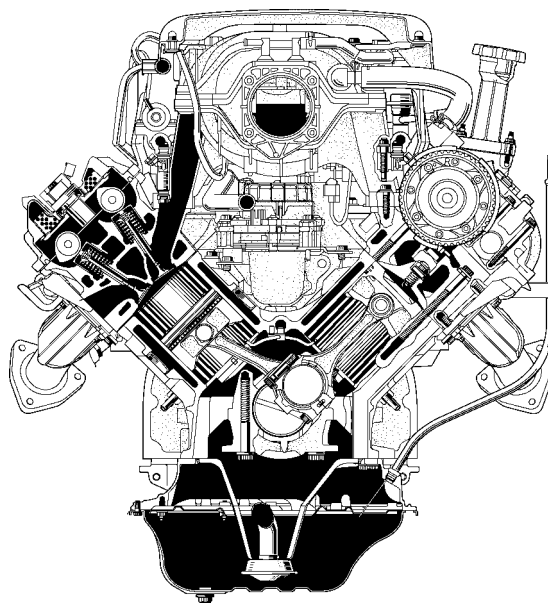
■ 2UZ-FE ENGINE

1. General

The 2UZ-FE engine is a V8, 4.7-liter, 32-valve DOHC engine. This engine is added the VVT-i (Variable Valve Timing-intelligent), ACIS (Acoustic Control Induction System), and AI (Air Injection) system to achieve high performance and reduce exhaust emissions. For details, see the major difference on page 146.



275TU60



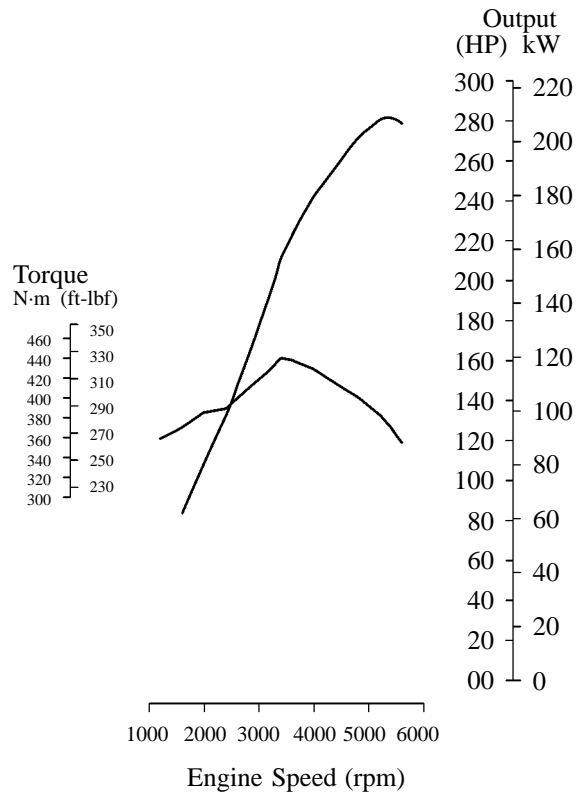
275TU61

● Engine Specifications ◀

Model		'05 Toyota Tundra	'04 Toyota Tundra	
Engine Type		2UZ-FE	←	
No. of Cyls. & Arrangement		8-Cylinder, V Type	←	
Valve Mechanism		32-Valve DOHC, Belt & Gear Drive (with VVT-i)	32-Valve DOHC, Belt & Gear Drive (without VVT-i)	
Combination Chamber		Pentroof Type	←	
Manifolds		Cross-Flow	←	
Fuel System		SFI	←	
Displacement	cm ³ (cu. in.)	4664 (284.5)	←	
Bore × Stroke	mm (in.)	94.0 × 84.0 (3.70 × 3.31)	←	
Compression Ratio		10.0 : 1	9.6 : 1	
Max. Output	(SAE-NET)	210 kW @ 5400 rpm (282 HP @ 5400 rpm)	183 kW @ 4800 rpm (245 HP @ 4800 rpm)	
Max. Torque	(SAE-NET)	440 N·m @ 3400 rpm (325 ft-lbf @ 3400 rpm)	427 N·m @ 3400 rpm (315 ft-lbf @ 3400 rpm)	
Valve Timing	Intake	Open	30° - -14° BTDC	3° BTDC
		Close	15° - 59° ABDC	36° ABDC
	Exhaust	Open	46° BBDC	←
		Close	3° ATDC	←
Firing Order		1- 8 - 4 - 3 - 6 - 5 - 7 - 2	←	
Research Octane Number		91 or higher	←	
Octane Rating		87 or higher	←	
Engine Service Mass* (Reference) kg (lb)		245 (540)	240 (529)	
Oil Grade		API SL, EC or ILSAC	←	
Tailpipe Emission Regulation	California	LEVII-ULEV, SFTP	ULEV, SFTP	
	Except California	Tier2-Bin8, SFTP		
Evaporative Emission Regulation		LEV-II, ORVR	←	

*: Weight shows the figure with the oil and engine coolant fully filled.

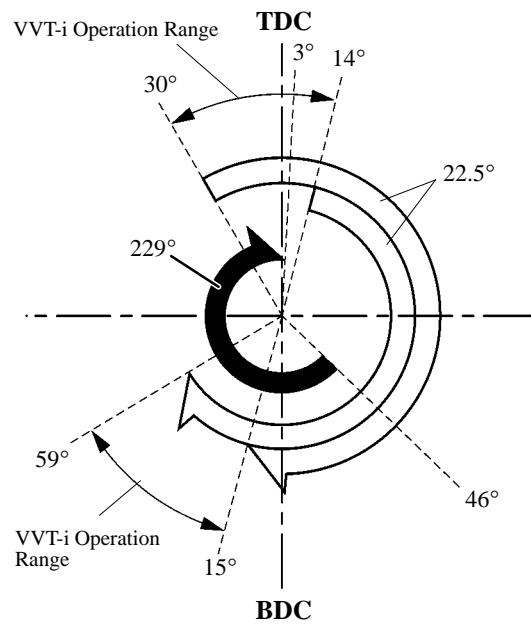
● Performance Curve ◀



275TU84

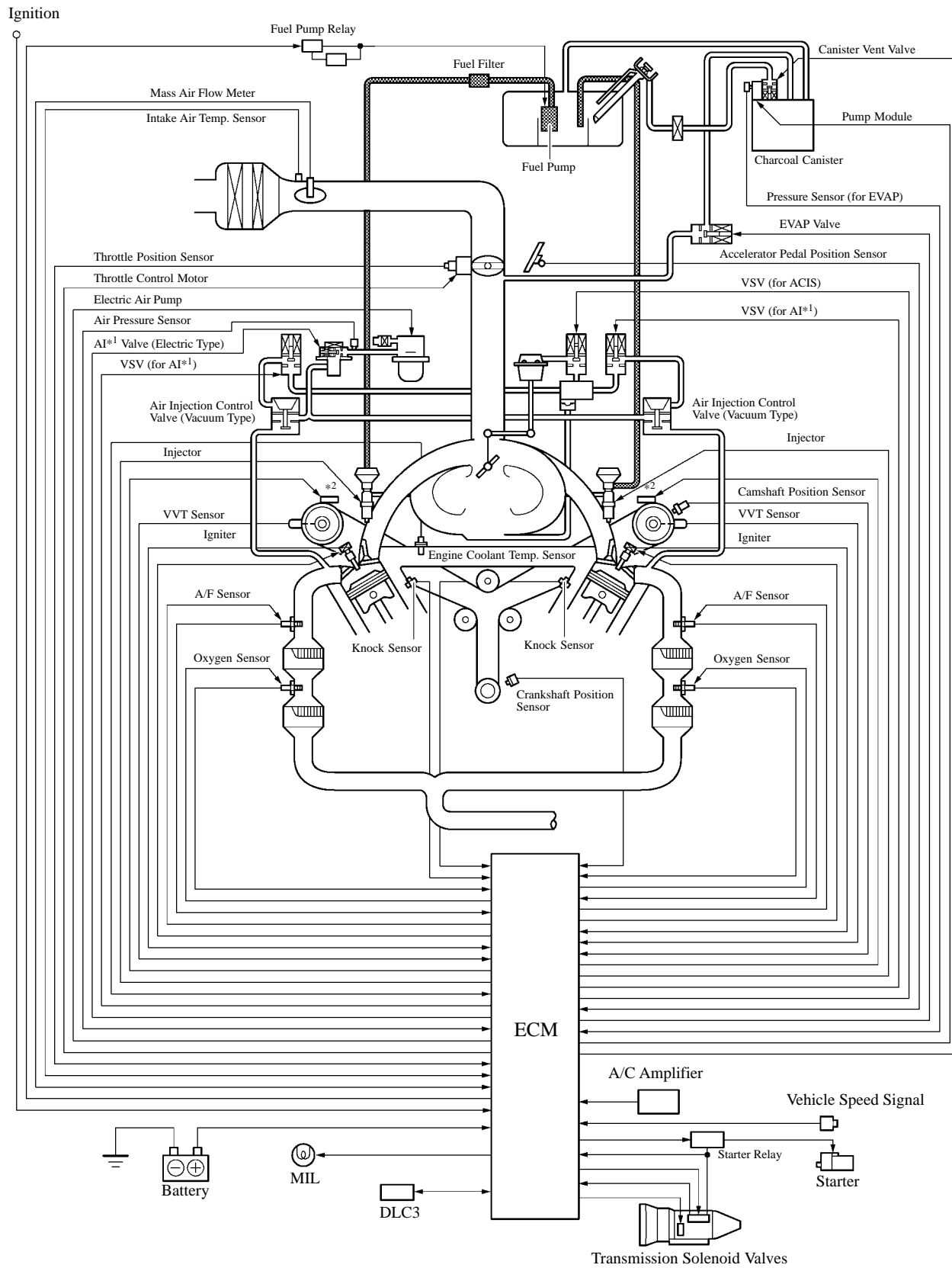
● Valve Timing ◀

◀ : Intake Valve Opening Angle
 ▶ : Exhaust Valve Opening Angle



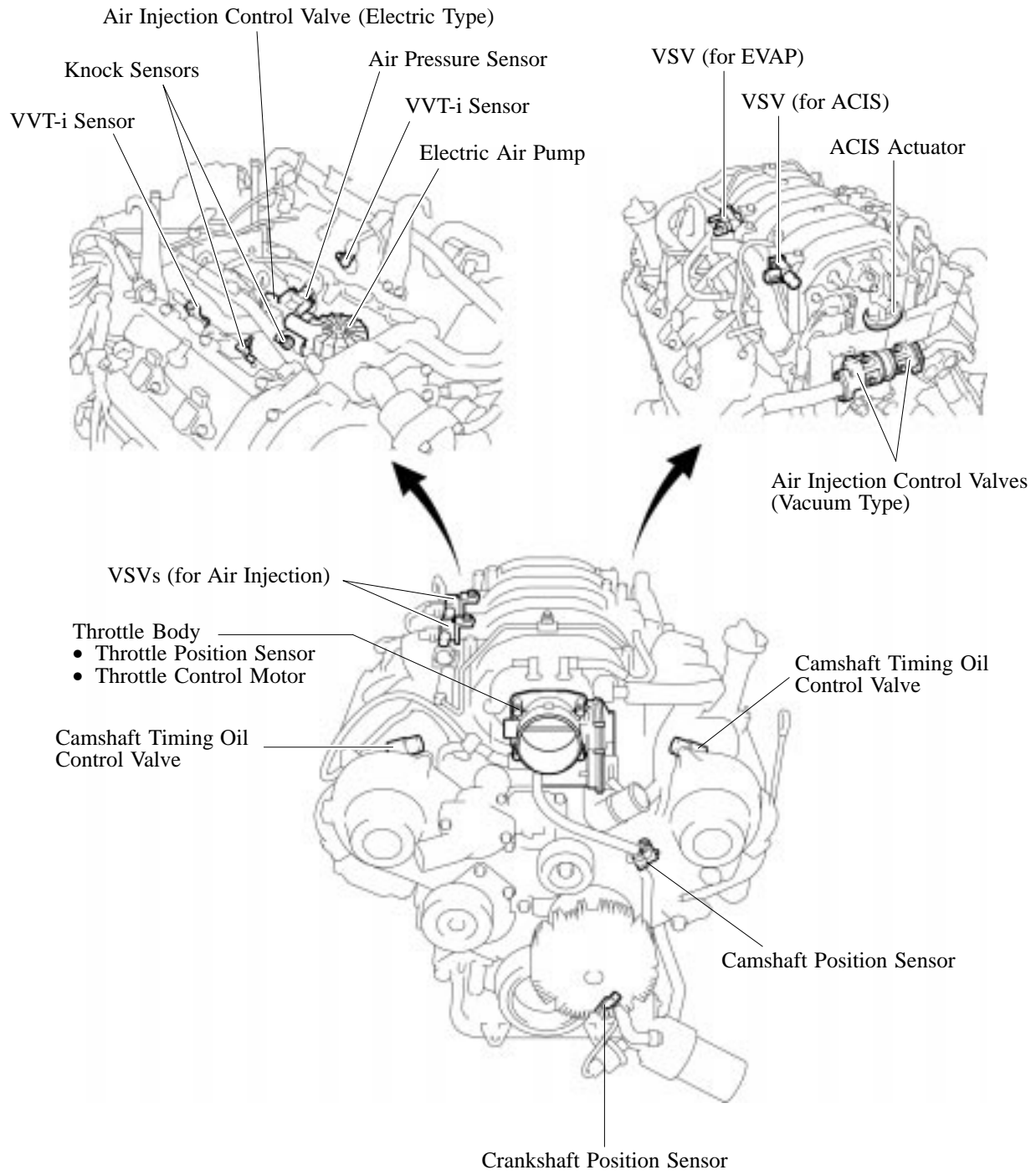
273GX03

Engine Control System Diagram



*1 AI: Air Injection
 *2: Camshaft Timing Oil Control Valve

Layout of Main Components



Main Components of Engine Control System

1) General

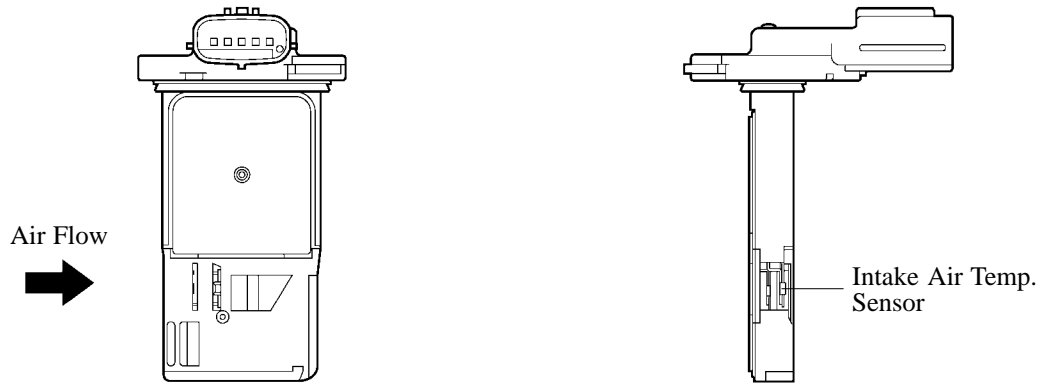
The main components of the 2UZ-FE engine control system are as follows:

Component	'05 Toyota Tundra		'04 4Runner	
	Outline	Quantity	Outline	Quantity
ECM	32-bit CPU	1	←	
Mass Air Flow Meter	Hot-wire Type (Slot-in)	1	Hot-wire Type (Plug-in)	1
Crankshaft Position Sensor (Rotor Teeth)	Pick-up Coil Type (36-2)	1	←	
Camshaft Position Sensor	Magnetic Resistance Element Type (1)	1	Pick-up Coil Type (1)	1
VVT Sensor LH, RH (Rotor Teeth)	Pick-up Coil Type (3)	1	-	
Accelerator Pedal Position Sensor	Linear (Contact) Type (Mounted on Accelerator Pedal)	1	No-contact Type (Mounted on Accelerator Pedal)	1
Throttle Position Sensor	No-contact Type	1	←	
Knock Sensor 1, 2	Built-in Piezoelectric Type (Non-resonant Type/ Flat Type)	2	Built-in Piezoelectric Type (Resonant Type)	2
Air Fuel Ratio Sensor (Bank 1, Sensor 1) (Bank 2, Sensor 1)	with Heater Type (Planar Type)	2	-	
Oxygen Sensor	(Bank 1, Sensor 1) (Bank 2, Sensor 1)	-		Type with Heater 2
	(Bank 1, Sensor 2) (Bank 2, Sensor 2)	Type with Heater	2	←
Injector	4-Hole Type	8	←	

2) Mass Air Flow Meter

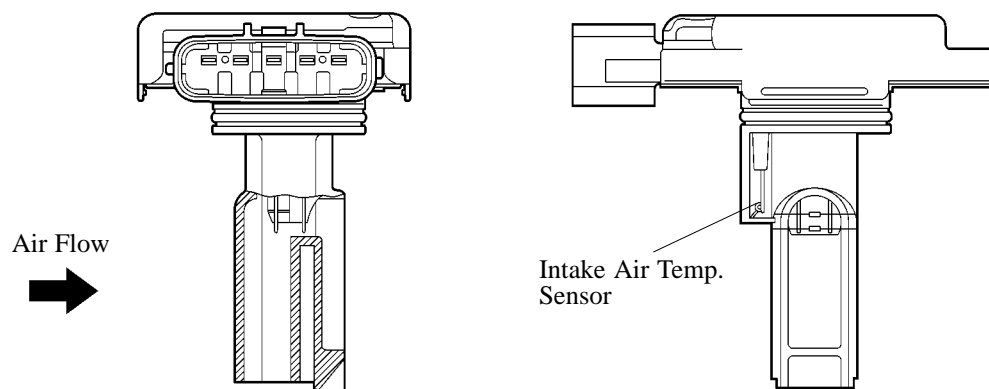
The mass air flow meter, which is a slot-in, allows a portion of the intake air to flow through the detection area. By directly measuring the mass and the flow rate of the intake air, the detection precision is ensured and the intake air resistance is reduced.

- This mass air flow meter has a built-in intake air temperature sensor.



'05 Toyota Tundra

273GX15

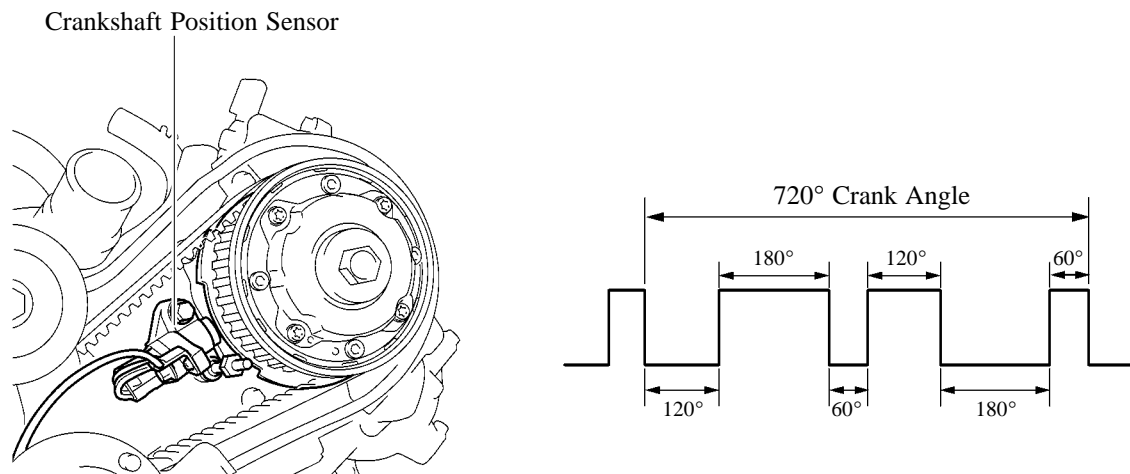


'04 Toyota Tundra

273GX16

3) Camshaft Position Sensor

The MRE (Magnetic Resistance Element) type camshaft position sensor converts changes in the magnetic field due to timing rotor rotation into internal circuit voltage. Unlike the pick-up type, an ON-OFF signal is output so that the sensor is not easily influenced by noise. This signal generates 1 pulse for every 2 revolutions of the crankshaft.



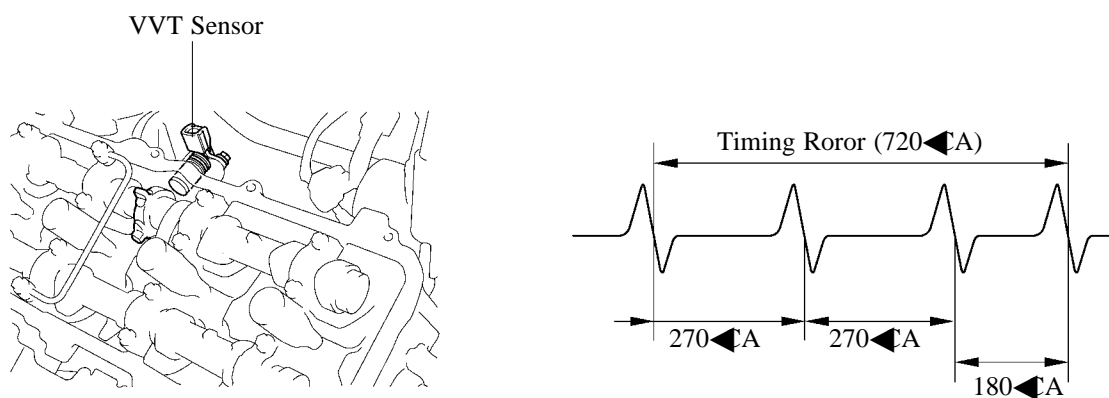
273GX77

Service Tip

The inspection method differs from the pick-up type because this sensor uses the MRE type. For details, refer to the 2005 Toyota Tundra Repair Manual (Pub. No. RM1150U).

4) VVT Sensor

A VVT sensor is mounted on the intake side of each cylinder head. To detect the camshaft position, a timing rotor that is provided on the intake camshaft is used to generate 3 pulses for every 2 revolutions of the crankshaft.



199EG38

5) Knock Sensor (Flat Type)

a. General

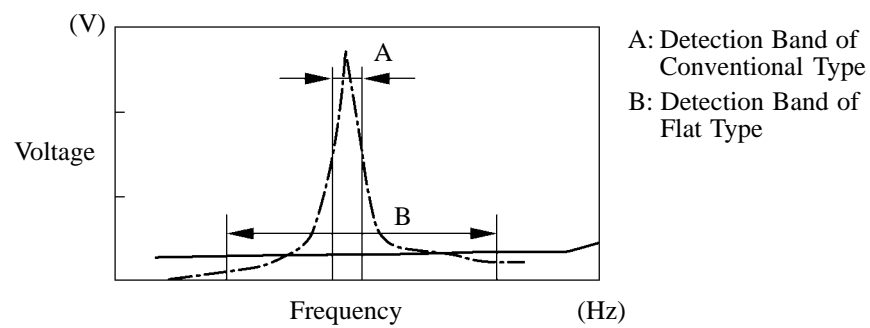
In the conventional type knock sensor (resonant type), a vibration plate, which has the same resonance point as the knocking frequency of the engine, is built in and can detect the vibration in this frequency band.

On the other hand, a flat type knock sensor (non-resonant type) has the ability to detect vibration in a wider frequency band from about 6 kHz to 15 kHz, and has the following features:

- The engine knocking frequency will change a bit depending on the engine speed. The flat type knock sensor can detect vibration even when the engine knocking frequency is changed. Thus the vibration detection ability is increased compared to the conventional type knock sensor, and a more precise ignition timing control is possible.

— . — : Resonance Characteristic of Conventional Type

———— : Resonance Characteristic of Flat Type

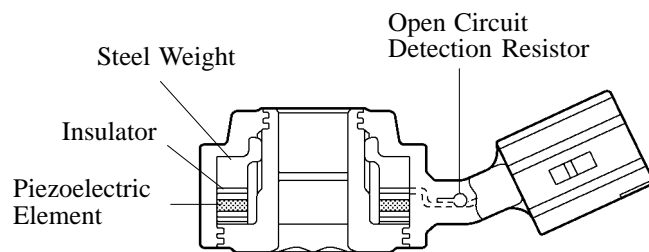


Characteristic of Knock Sensor

214CE04

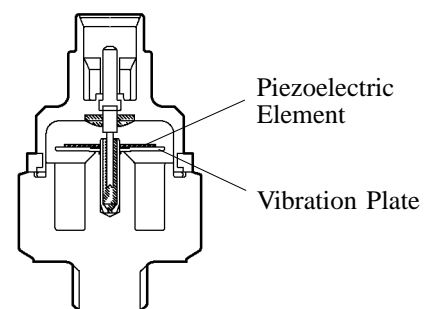
b. Construction

- The flat type knock sensor is installed on the engine through the stud bolt installed on the cylinder block. For this reason, a hole for the stud bolt is running through in the center of the sensor.
- Inside of the sensor, a steel weight is located on the upper portion and a piezoelectric element is located under the weight through the insulator.
- The open/short circuit detection resistor is integrated.



Flat Type Knock Sensor (Non-Resonant Type)

214CE01

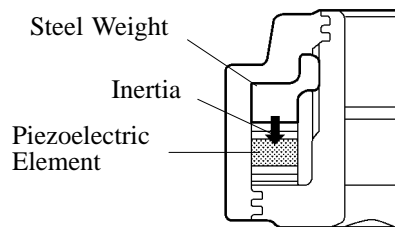


Conventional Type Knock Sensor (Resonant Type)

214CE02

c. Operation

The knocking vibration is transmitted to the steel weight and its inertia and they apply pressure to the piezoelectric element. The action generates electromotive force.

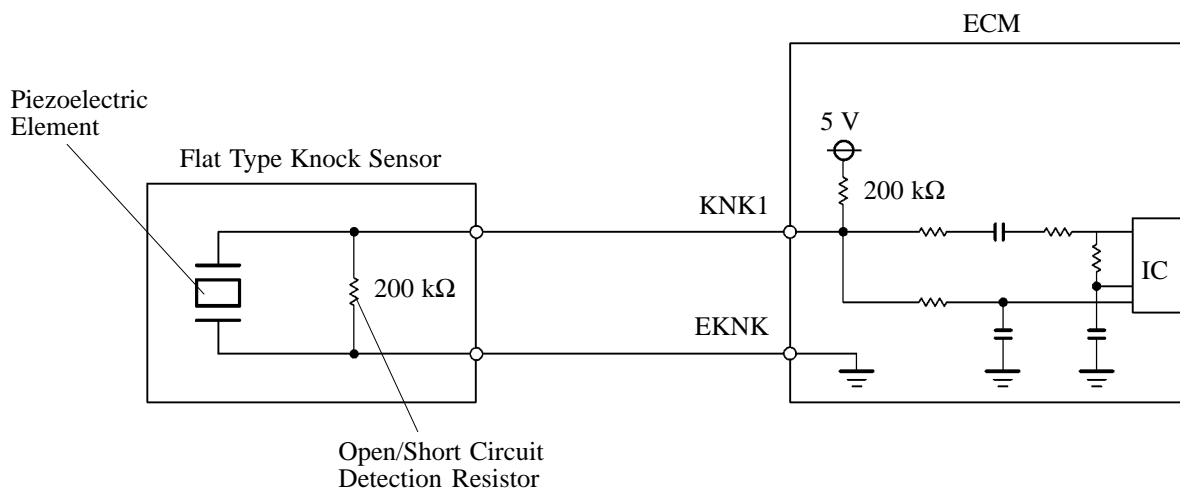


214CE08

d. Open/Short Circuit Detection Resistor

During the ignition is ON, the open/short circuit detection resistor in the knock sensor and the resistor in the ECM keep the voltage at the terminal KNK1 of engine constantly.

An IC (Integrated Circuit) in the ECM is always monitoring the voltage of the terminal KNK1. If the open/short circuit occurs between the knock sensor and the ECM, the voltage of the terminal KNK1 will change and the ECM detects the open/short circuit and stores DTC (Diagnostic Trouble Code).



214CE06

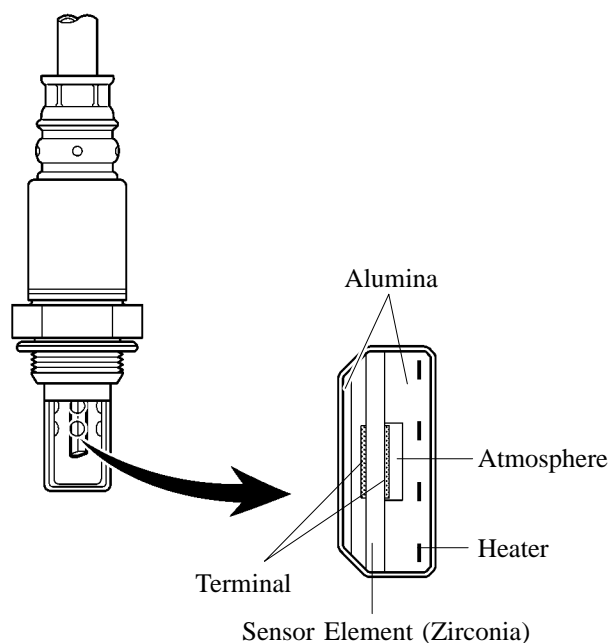
Service Tip

In accordance with the adoption of an open/short circuit detection resistor, the inspection method for the sensor has been changed. For details, refer to the 2005 Toyota Tundra Repair Manual (Pub. No. RM1150U).

6) Air Fuel Ratio Sensor

a. General

The planar type A/F sensor uses alumina, which excels in heat conductivity and insulation, to integrate a sensor element with a heater, thus improving the warm-up performance (warm-up time: approx. 10 seconds) of the sensor.



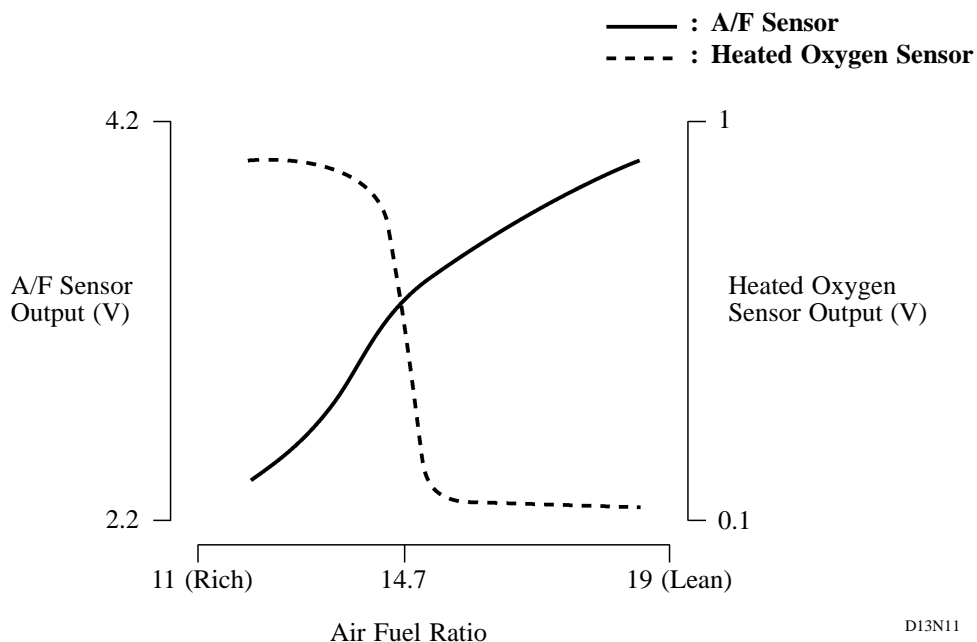
D13N12

b. Characteristic

The heated oxygen sensor and the air fuel ratio sensor differ in output characteristics.

- The heated oxygen sensor is characterized by a sudden change in its output voltage at the threshold of the stoichiometric air fuel ratio (14.7: 1).
- The air fuel ratio sensor outputs a voltage that is approximately proportionate to the existing air fuel ratio by converting the oxygen density to the voltage.

As a result, the detection precision of the air fuel ratio has been improved.

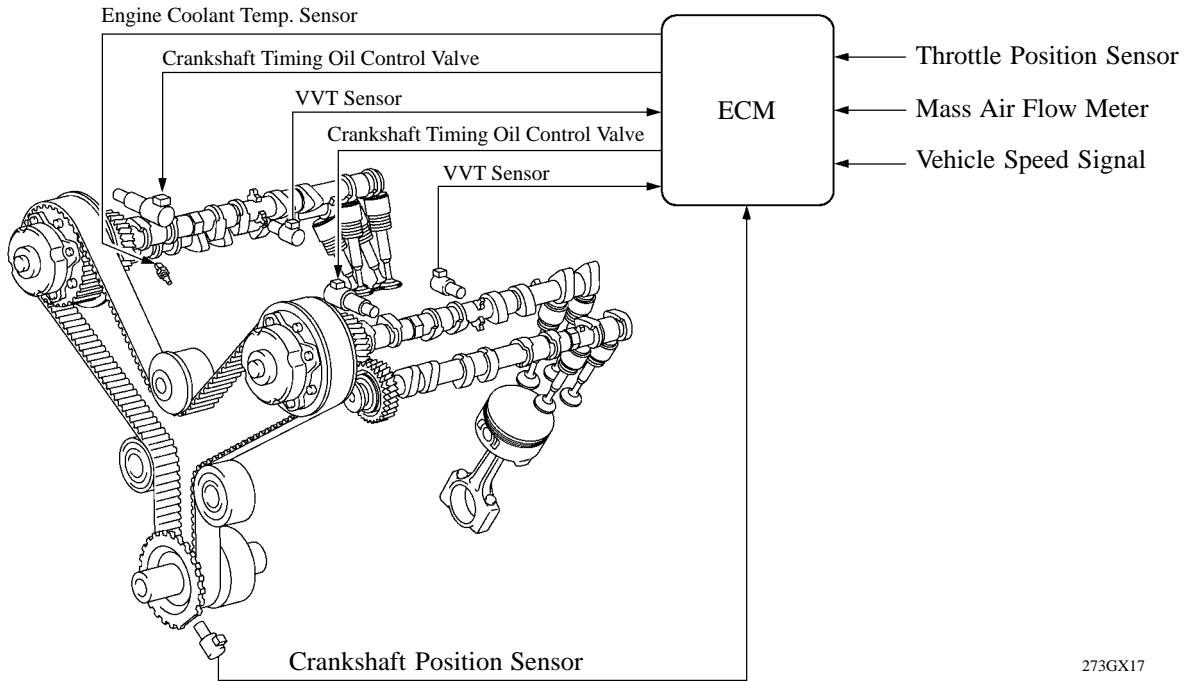


D13N11

VVT-i (Variable Valve Timing-intelligent) System

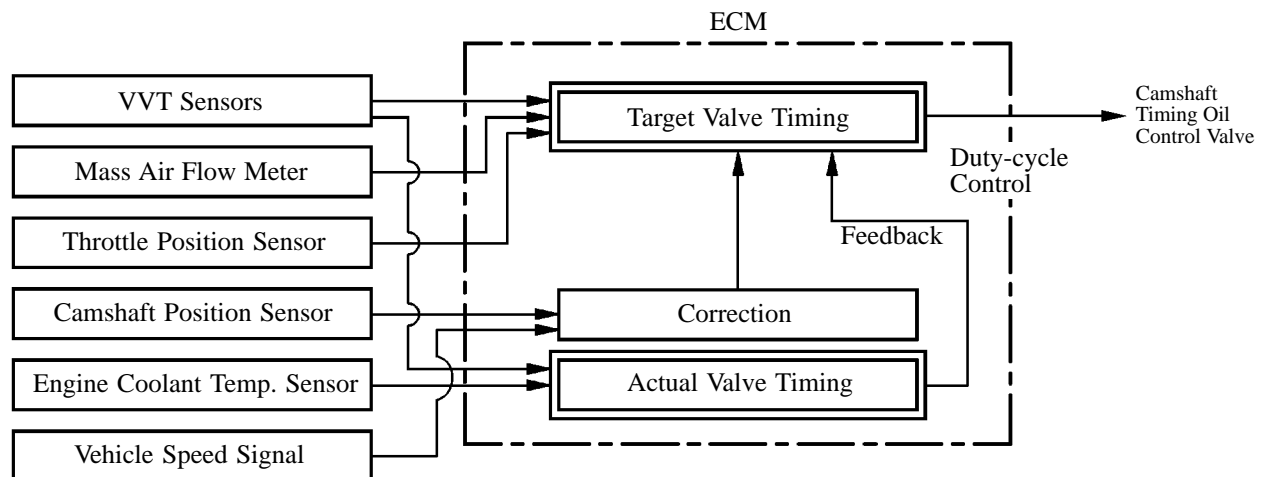
1) General

- The VVT-i system is designed to control the intake camshaft within a range of 44° (of Crankshaft Angle) to provide valve timing that is optimally suited to the engine condition. This improves torque in all the speed ranges as well as increasing fuel economy, and reducing exhaust emissions.



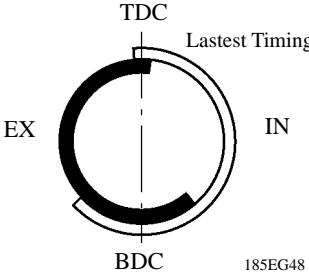
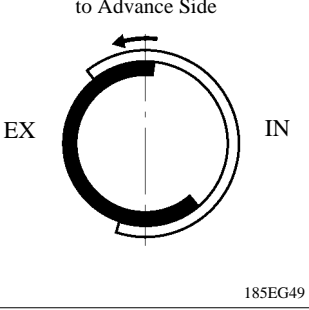
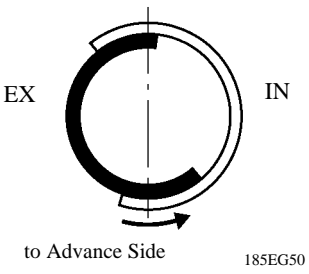
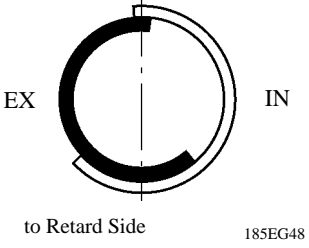
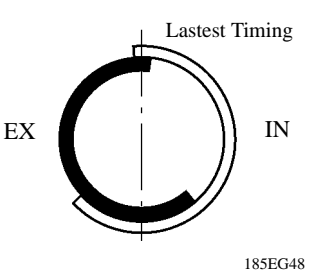
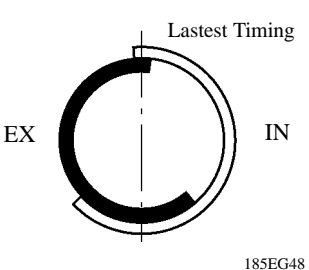
273GX17

- By using the engine speed, intake air volume, throttle position and engine coolant temperature, the ECM calculates optimal valve timing for each driving condition and controls the camshaft timing oil control valve. In addition, the ECM uses signals from two VVT sensors and the crankshaft position sensor to detect the actual valve timing, thus providing feedback control to achieve the target valve timing.



221EG16

2) Effectiveness of the VVT-i System

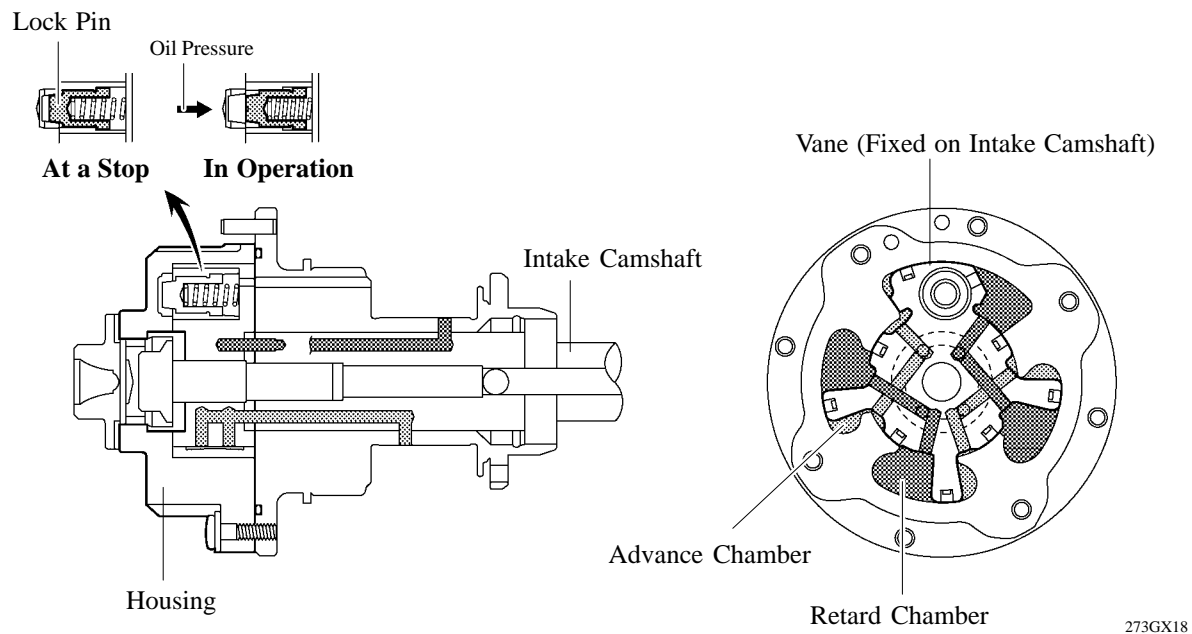
Operation State	Objective	Effect
<ul style="list-style-type: none"> • During Idling • At Light Load 	 <p>Minimizing overlap to reduce blowback to the intake side</p>	<ul style="list-style-type: none"> • Stabilized idling rpm • Better fuel economy
At Medium Load	 <p>Increasing overlap increases internal EGR, reducing pumping loss</p>	<ul style="list-style-type: none"> • Better fuel economy • Improved emission control
In Low to Medium Speed Range with Heavy Load	 <p>Advancing the intake valve close timing for volumetric efficiency improvement</p>	Improved torque in low to medium speed range
In High Speed Range with Heavy Load	 <p>Retarding the intake valve close timing for volumetric efficiency improvement</p>	Improved output
At Low Temp.	 <p>Minimizing overlap to prevent blowback to the intake side leads to the lean burning condition, and stabilizes the idling speed at fast idle</p>	<ul style="list-style-type: none"> • Stabilized fast idle rpm • Better fuel economy
<ul style="list-style-type: none"> • Upon Starting • Stopping the Engine 	 <p>Minimizing overlap to minimize blowback to the intake side</p>	Improved startability

3) Construction

a. VVT-i Controller

VVT-i controller consists of the housing, four vanes, and lock pin. The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.

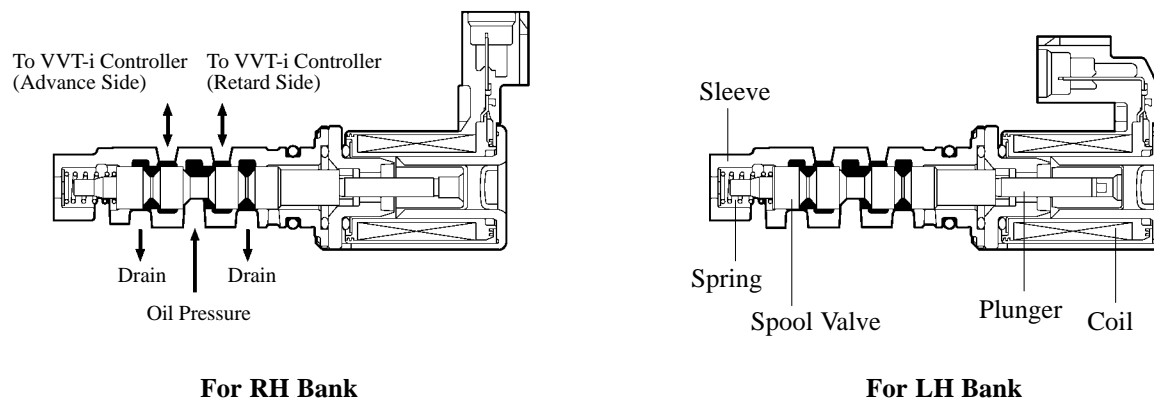
When the engine is stopped, the intake camshaft will be in the most retarded state to ensure startability. When oil pressure is not applied to the VVT-i controller immediately after the engine has been started, the lock pin locks the movement of the VVT-i controller to prevent a knocking noise.



273GX18

b. Camshaft Timing Oil Control Valve

The camshaft timing oil control valve controls the spool valve position in accordance with the duty control from the ECM thus allocating the hydraulic pressure that is applied to the VVT-i controller to the advance and the retard side. When the engine is stopped, the camshaft timing oil control valve is in the most retarded state.

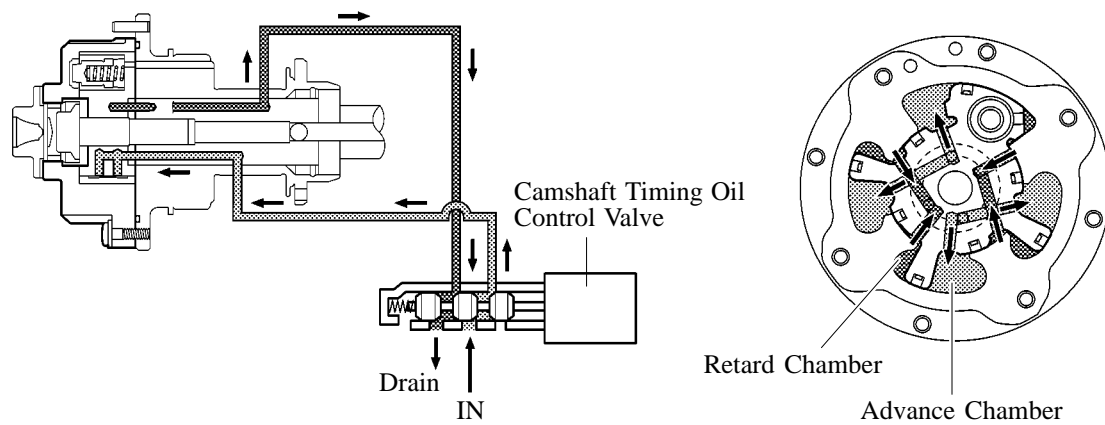


273GX73

4) Operation

a. Advance

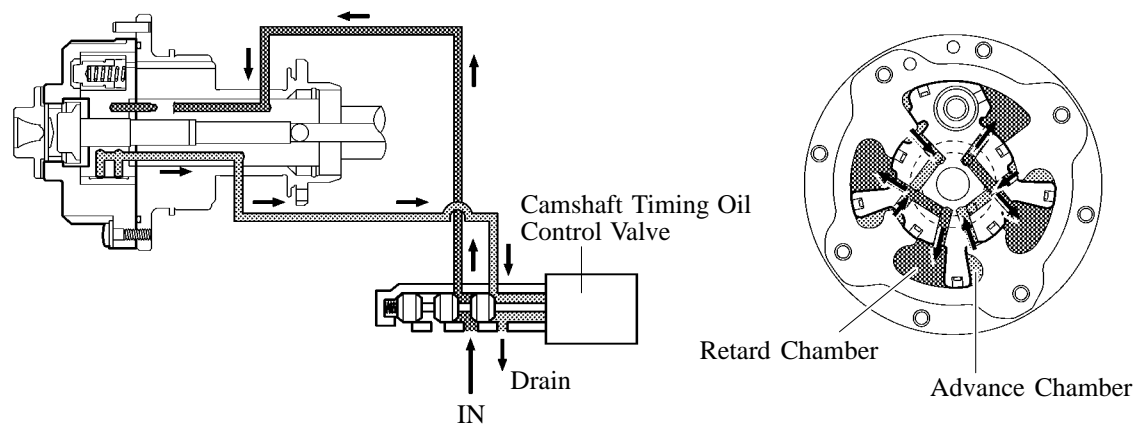
When the camshaft timing oil control valve is positioned as illustrated below by the advance signal from the ECM, the resultant oil pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.



273GX19

b. Retard

When the camshaft timing oil control valve is positioned as illustrated below by the retard signal from the ECM, the resultant oil pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.



273GX20

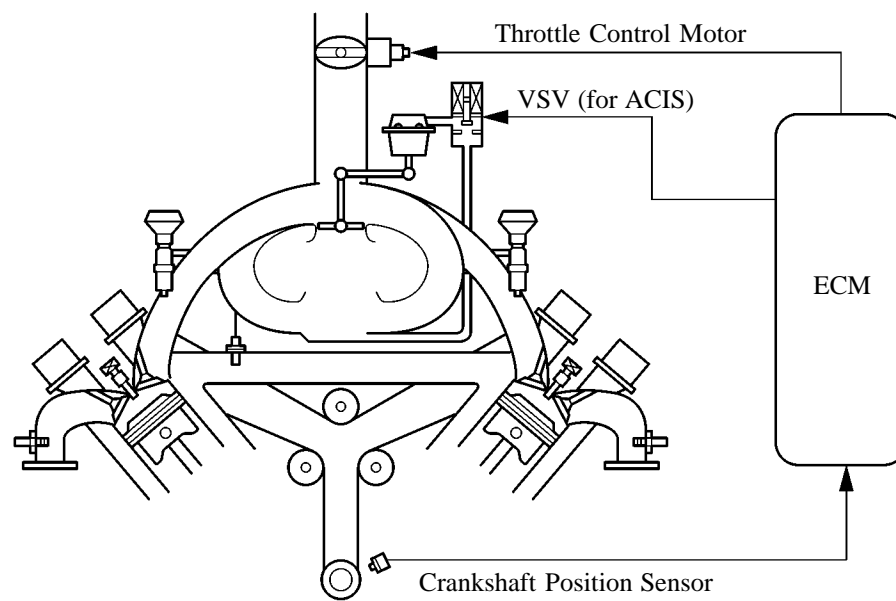
c. Hold

After reaching the target timing, the valve timing is held by keeping the camshaft timing oil control valve in the neutral position unless the traveling state changes. This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

ACIS (Acoustic Control Induction System)

1) General

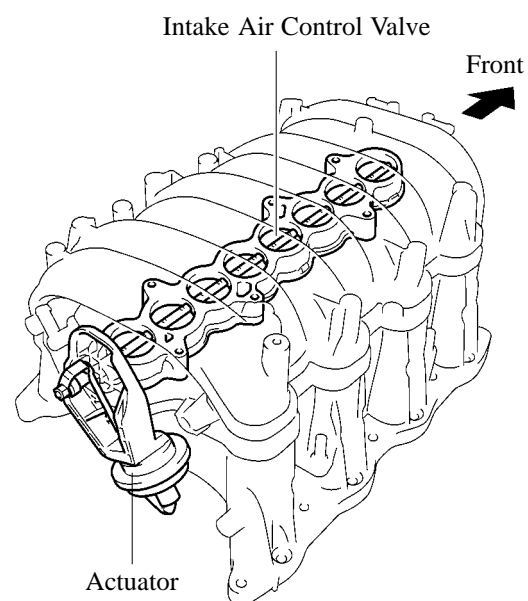
The ACIS is realized by using a bulkhead to divide the intake manifold into two stages, with an intake air control valve in the bulkhead being opened and closed to vary the effective length of the intake manifold in accordance with the engine speed and throttle valve opening angle. This increases the power output in all ranges from low to high speed.



273GX21

2) Intake Air Control Valve and Actuator

The intake air control valve and actuator are integrated with the intake manifold. This valve opens and closes to change the effective length of the intake manifold in two stages.



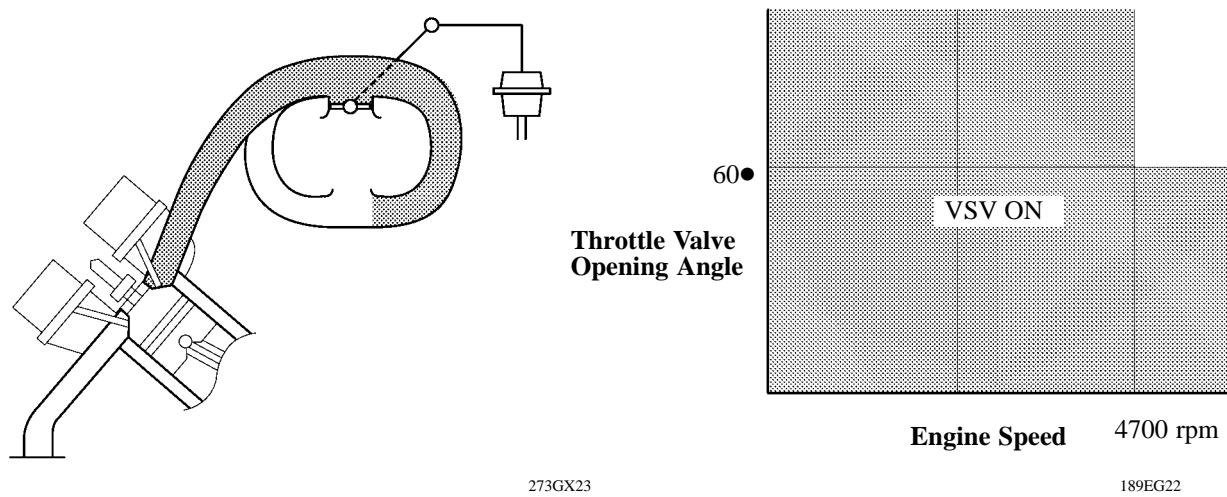
273GX22

3) Operation

a. When the Intake Control Valve Closes (VSV ON)

The ECM activates the VSV to match the longer pulsation cycle so that the negative pressure acts on the diaphragm chamber of the actuator. This closes the control valve. As a result, the effective length of the intake manifold is lengthened and the intake efficiency in the low-to-medium speed range is improved due to the dynamic effect of the intake air, thereby increasing the power output.

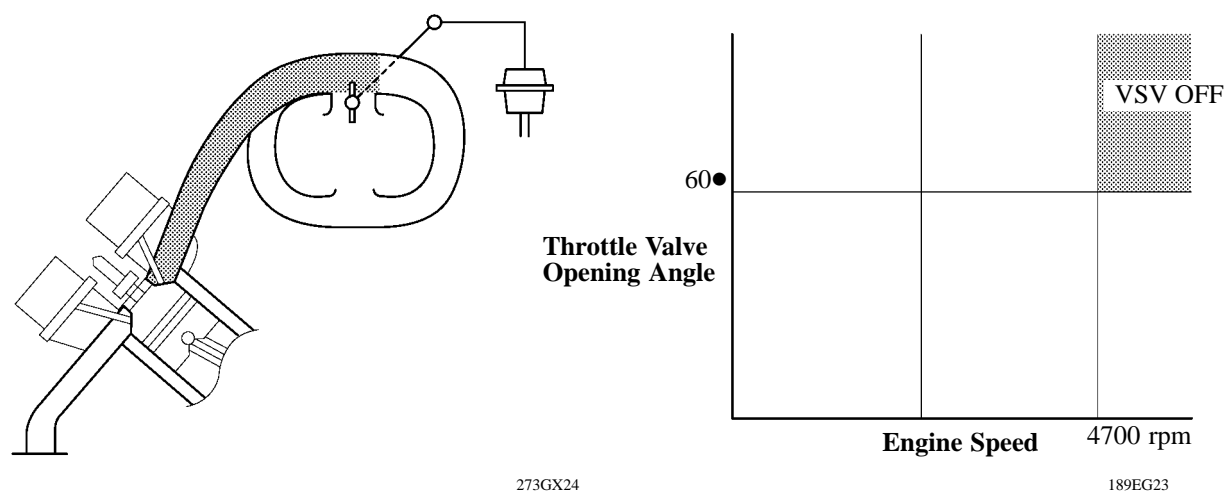
 : Effective Intake Manifold Length



b. When the Intake Control Valve Opens (VSV OFF)

The ECM deactivates the VSV to match the shorter pulsation cycle so that atmospheric air is led into the diaphragm chamber of the actuator and opens the control valve. When the control valve is open, the effective length of the intake air chamber is shortened and peak intake efficiency is shifted to the high engine speed range, thus providing greater output at high engine speeds.

 : Effective Intake Manifold Length



Air Injection System

1) General

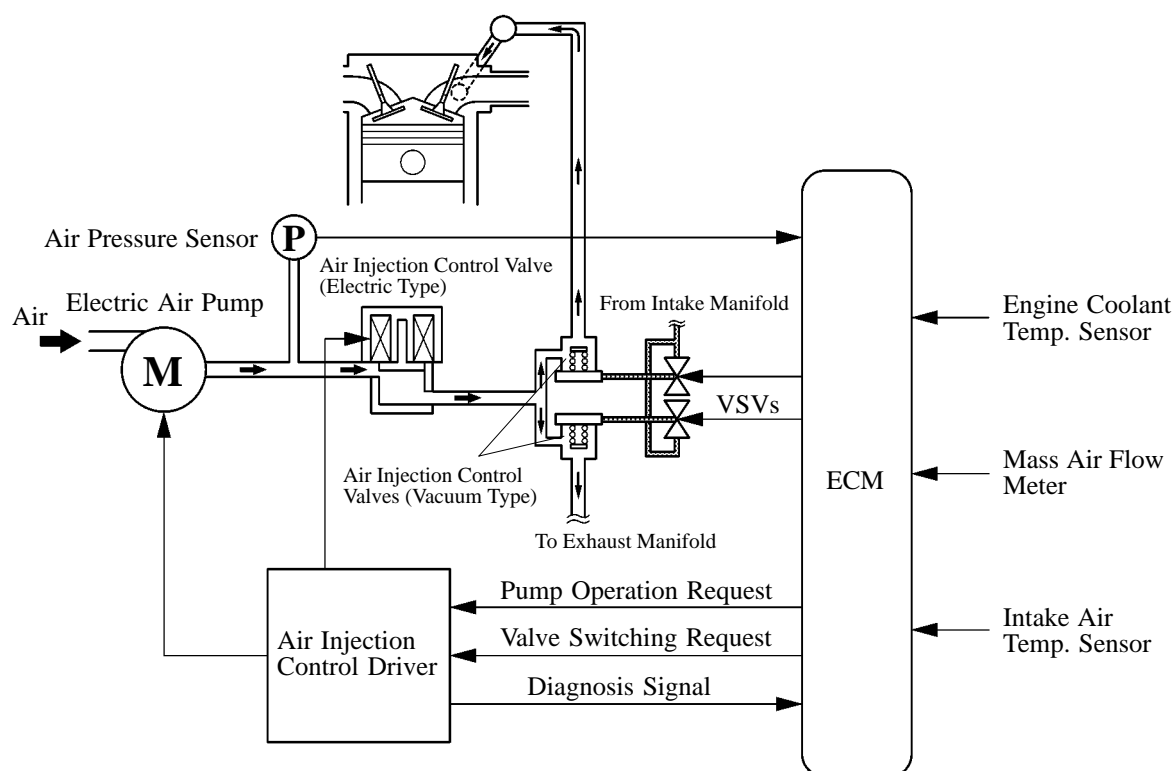
To ensure the proper warm-up performance of the TWC when starting a cold engine, an air injection system is used.

- This system consists of an electric air pump, an air injection control driver, two air injection control valves (vacuum type), an air injection control valve (electric type), and two VSVs.
- The ECM estimates the amount of air injected to the TWC (Three-Way catalytic Converter) based on signals from the mass air flow meter in order to regulate the air injection time.
- The air injection operates under the following operation conditions.

● Operation Condition ◀

Engine Coolant Temp.	41 to 104°F (5 to 40°C)
Intake Air Temp.	41°F (5°C) or more

● System Diagram ◀

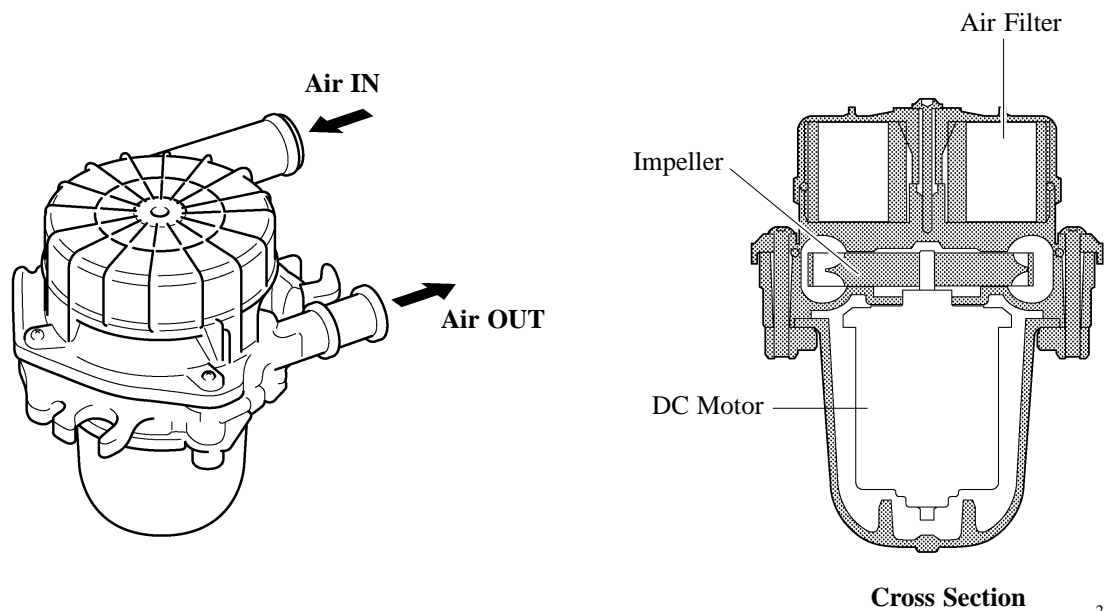


2) Construction and Function of Main Components

a. Electric Air Pump

An electric air pump consists of a DC motor, an impeller and an air filter.

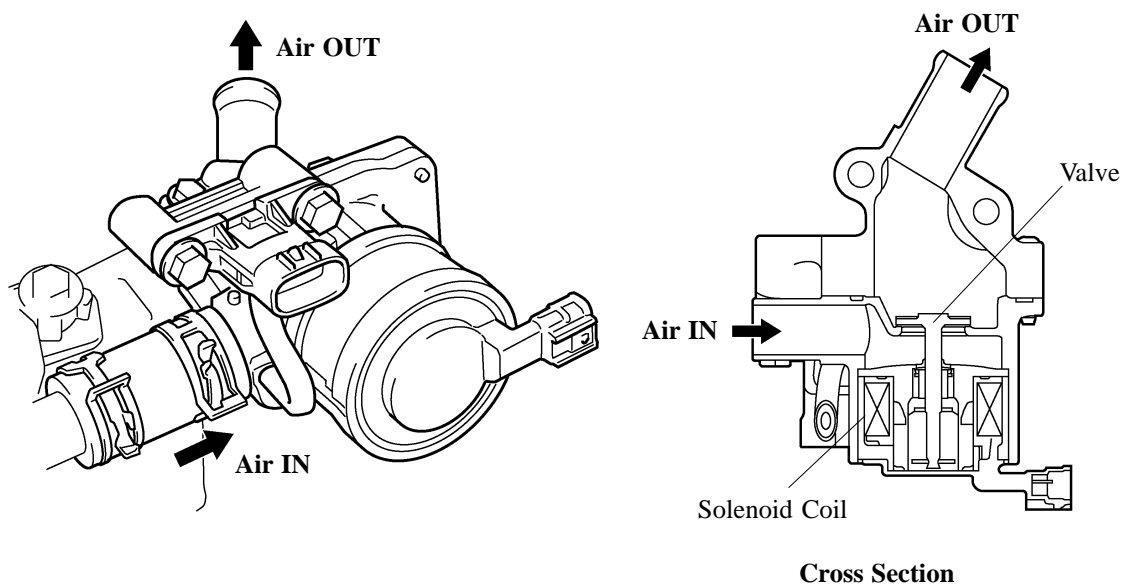
- The pump supplies air into an air injection control valve (electric type) through the impeller.
- The air filter is maintenance-free.



273GX79

b. Air Injection Control Valve (Electric Type)

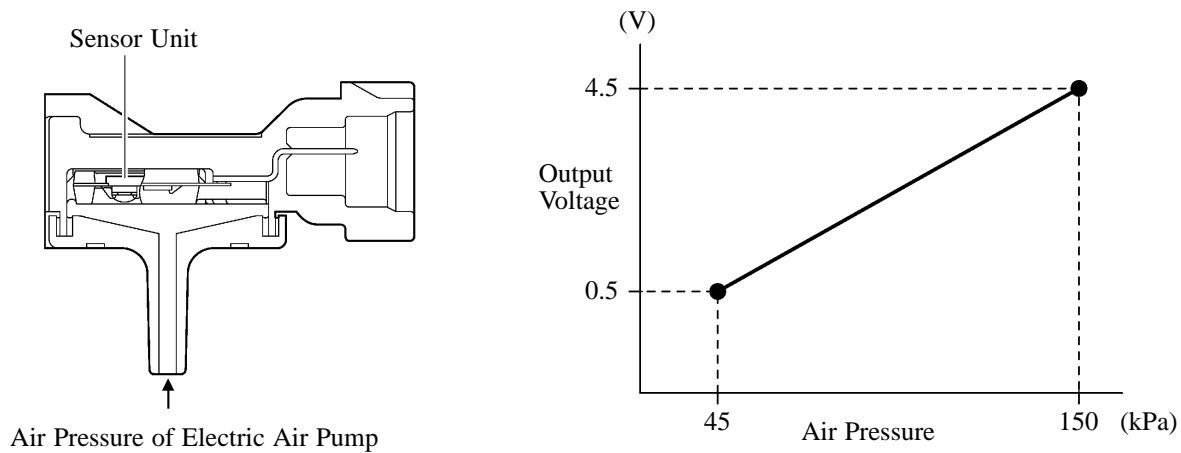
The air injection control valve (electric type) is operated by a solenoid coil to control air injection and prevent back-flow of exhaust gas. Opening timing of the valve is synchronized with operation timing of the electric air pump.



273GX26

c. Air Pressure Sensor

The air pressure sensor consists of a semiconductor, which utilized the characteristics of silicon chip that changes its electrical resistance when pressure is applied to it. The sensor converts the pressure into an electrical signal, and sends it to the ECM in an amplified form.



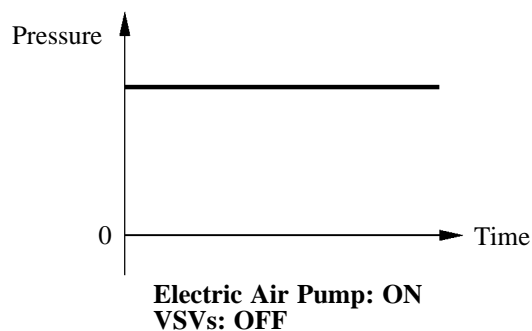
257MA21

257MA22

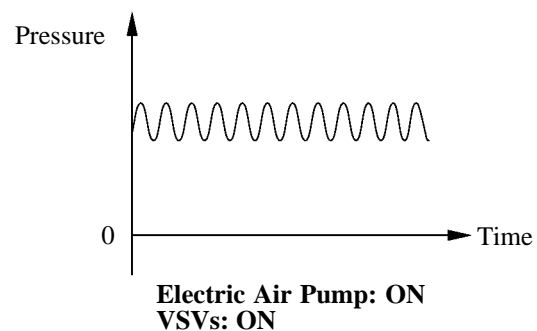
The ECM detects operation condition of the air injection system based on signals from the air pressure sensor as follows:

- 1) When the electric air pump is ON and the VSVs are OFF, the pressure is constant.
- 2) When the VSVs are turned ON with the electric air pump ON and all air injection control valves open, the pressure drops slightly and becomes unstable because of exhaust-pulse.
- 3) When the electric air pump is OFF and the VSVs are OFF, the pressure remains 0.
- 4) When the VSVs are turned OFF with the electric air pump ON and all air injection control valves open, the pressure drops below 0 and becomes unstable because of exhaust-pulse.

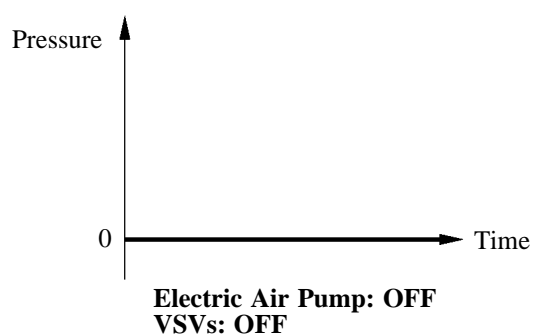
Example: 1



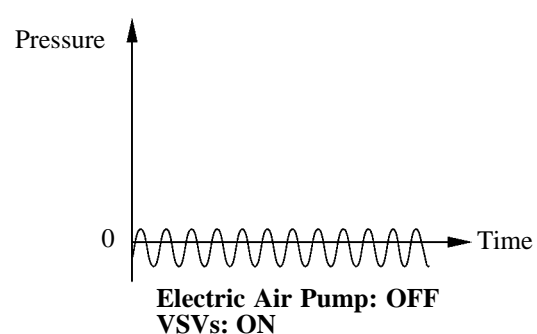
Example: 2



Example: 3



Example: 4

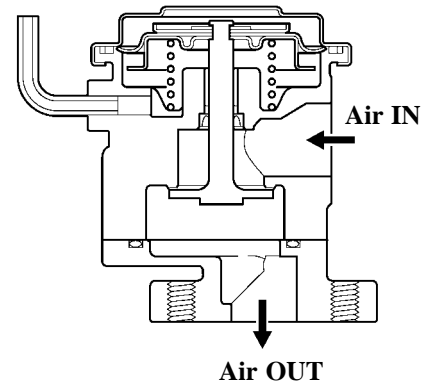
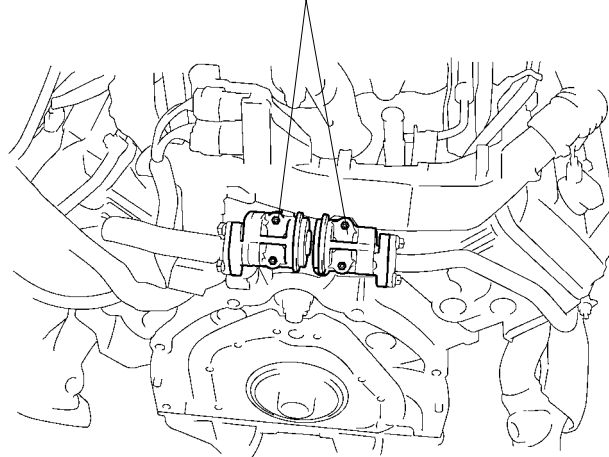


273GX81

d. Air Injection Control Valve (Vacuum Type)

The air injection control valve (vacuum type) switches according to the vacuum pressure introduced by VSV.

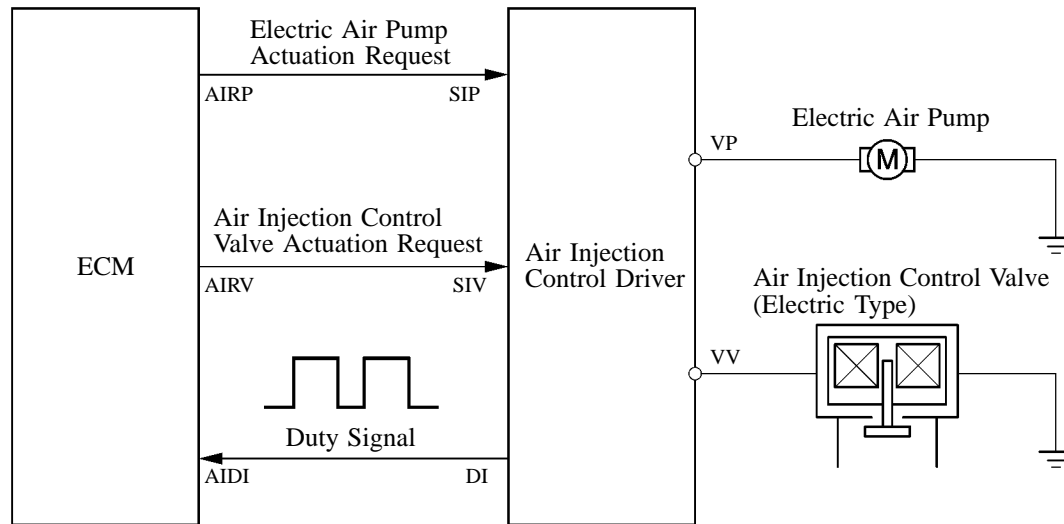
Air Injection Control Valves (Vacuum Type)



273GX27

e. Air Injection Control Driver

- The air injection control driver uses semiconductor. Activated by the ECM, this driver actuates the electric air pump and the air injection control valve.
- The air injection control driver also detects failures in the input and output circuits at the air injection driver and transmits the failure status to the ECM via duty cycle signals.



271EG64

● **DI Terminal Output** ◀

Condition	AIRP	AIRV	Output (Duty Signal)
Open circuit in line between AIDI and DI terminals.	-	-	 GND ————— 273GX28
Failure in line between ECM terminals and air injection control driver.	-	-	 GND ————— 273GX29
Output failure at air injection control driver. (Failure in electric air pump actuation circuit)	-	-	 GND ————— 273GX30
Output failure at air injection control driver. (Failure in air switching valve actuation circuit)	-	-	 GND ————— 273GX31
Overheat failure of air injection control driver.	-	-	 GND ————— 273GX32
Normal	ON	ON	 GND ————— 273GX33
	OFF	OFF	 GND ————— 273GX29
	ON	OFF	
	OFF	ON	

Evaporative Emission Control System

For details, see page 130 in IGR-FE engine Section.

Diagnosis

The following DTCs (Diagnostic Trouble Codes) are added and discontinued.

● Added DTC Chart ◀

DTC	Detection Item	DTC	Detection Item
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	P0346	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 2)
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	P043E	Evaporative Emission Control System Reference Orifice Clog Up
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	P043F	Evaporative Emission Control System Reference Orifice High Flow
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	P0450	Evaporative Emission Control System Pressure Sensor/Switch
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	P0452	Evaporative Emission Control System Pressure Sensor/Switch Low Input
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	P0453	Evaporative Emission Control System Pressure Sensor/Switch High Input
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	P0456	Evaporative Emission Control System Leak Detected
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	P0491	Secondary Air Injection System (Bank 1)
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	P1340	Igniter Circuit Malfunction
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	P1341	Camshaft Position Sensor "A" (Bank 1 Sensor 2)
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	P1440	Secondary Air Injection System VSV Malfunction
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	P1441	Secondary Air Injection System Switching Valve Stuck Open
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	P1442	Secondary Air Injection System Switching Valve Stuck Closed
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	P1443	Secondary Air Injection System VSV Malfunction
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	P1444	Secondary Air Injection System Switching Valve Stuck Open
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	P1445	Secondary Air Injection System Switching Valve Stuck Closed
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	P2237	A/F Sensor Pumping Current Circuit/Open (for A/F sensor) (Bank 1 Sensor 1)

(Continued)

DTC	Detection Item	DTC	Detection Item
P2238	A/F Sensor Pumping Current Circuit Low (for A/F sensor) (Bank 1 Sensor 1)	P2419	Evaporate Emission System Switching Valve Control Circuit Low
P2239	A/F Sensor Pumping Current Circuit High (for A/F sensor) (Bank 1 Sensor 1)	P2420	Evaporate Emission System Switching Valve Control Circuit High
P2240	A/F Sensor Pumping Current Circuit/Open (for A/F sensor) (Bank 2 Sensor 1)	P2430	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Bank 1
P2241	A/F Sensor Pumping Current Circuit Low (for A/F sensor) (Bank 2 Sensor 1)	P2431	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Range/Performance Bank 1
P2242	A/F Sensor Pumping Current Circuit High (for A/F sensor) (Bank 2 Sensor 1)	P2432	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Low Bank 1
P2251	A/F Sensor Reference Ground Circuit/Open (for A/F sensor) (Bank 1 Sensor 1)	P2433	Secondary Air Injection System Air Flow/Pressure Sensor Circuit High Bank 1
P2252	A/F Sensor Reference Ground Circuit Low (for A/F sensor) (Bank 1 Sensor 1)	P2440	Secondary Air Injection System Switching Valve Stuck Open
P2253	A/F Sensor Reference Ground Circuit High (for A/F sensor) (Bank 1 Sensor 1)	P2441	Secondary Air Injection System Switching Valve Stuck Closed
P2254	A/F Sensor Reference Ground Circuit/Open (for A/F sensor) (Bank 2 Sensor 1)	P2444	Secondary Air Injection System Pump Stuck On Bank 1
P2255	A/F Sensor Reference Ground Circuit Low (for A/F sensor) (Bank 2 Sensor 1)	P2445	Secondary Air Injection System Pump Stuck Off Bank 1
P2256	A/F Sensor Reference Ground Circuit High (for A/F sensor) (Bank 2 Sensor 1)	P2610	ECM/PCM Internal Engine Off Timer Performance
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	P2A00	A/F sensor circuit slow response (Bank 1 Sensor 1)
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	P2A03	A/F sensor circuit slow response (Bank 2 Sensor 2)

● **Discontinued DTC Chart** ◀

DTC	Detection Item	DTC	Detection Item
P0130	Oxygen Sensor Circuit (Bank 1 Sensor 1)	P0150	Oxygen Sensor Circuit (Bank 2 Sensor 1)
P0133	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 1)	P0153	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 1)
P0134	Oxygen Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	P0154	Oxygen Sensor Circuit No Activity Detected (Bank 2 Sensor 1)

2. Major Difference

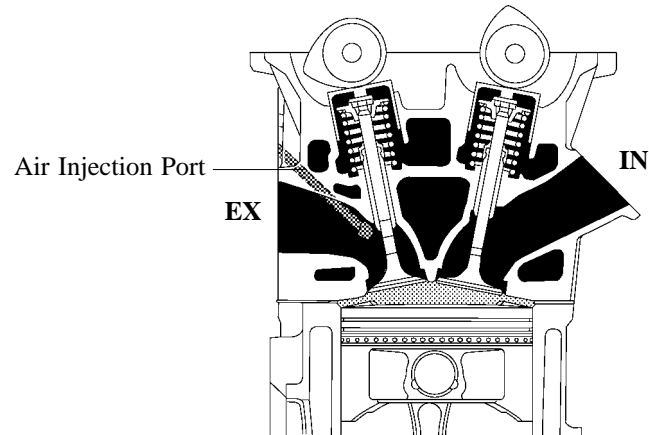
The major difference between the new 2UZ-FE engine on the '05 Toyota Tundra and the 2UZ-FE engine on the '04 Toyota Tundra are the following:

System		Features
Engine Specification		According to various changes, the following specifications are changed. <ul style="list-style-type: none"> • Valve Mechanism • Compression Ratio • Intake Valve Timing • Max. Output and Torque • Engine Service Mass
Engine Proper	Cylinder Head	<ul style="list-style-type: none"> • A lead-free valve seat is used. • The passage for the air injection is added.
	Cylinder Block	<ul style="list-style-type: none"> • A lead-free crankshaft bearing is used. • Oil jet for piston is added.
	Piston	Piston shape is changed.
	Connecting Rod	A lead-free connecting rod bearing is used.
Valve Mechanism		Intake camshaft for the VVT-i (Variable Valve Timing-intelligent) is used.
Lubrication System		Oil passage for the VVT-i and oil jet for the piston are added.
Intake and Exhaust System		<ul style="list-style-type: none"> • The throttle body shape is changed. • The material of the intake manifold is changed from aluminum to plastic. • The air injection pipe is provided on the exhaust manifold. • The capacity of the TWC (Three-Way Catalytic Converter) has been changed.
Fuel System		<ul style="list-style-type: none"> • The fuel tank has been changed from steel to multi-layer plastic. • The fuel filler pipe has been changed from steel to stainless steel.
Ignition System		The spark plug has been changed from conventional type spark plug to iridium-tipped spark plug.
Engine Control System		<ul style="list-style-type: none"> • Mass air flow meter is changed from the plug-in type to the slot-in type. • Camshaft position sensor is changed from the pick-up type to the magnetic resistance element type. • Two VVT-i sensors are added. • Knock sensor is changed from the resonant type to the non-resonant type. • Two air fuel ratio sensors are used. • Idle speed, when the shift position is D, is changed from 600 rpm to 550 rpm. • VVT-i control is added. • ACIS (Acoustic Control Induction System) control is added. • Air injection control is added. • The construction of the evaporative emission control system is changed.
Diagnosis		Some DTCs (Diagnostic Trouble Codes) have been added and discontinued.

3. Engine Proper

Cylinder Head

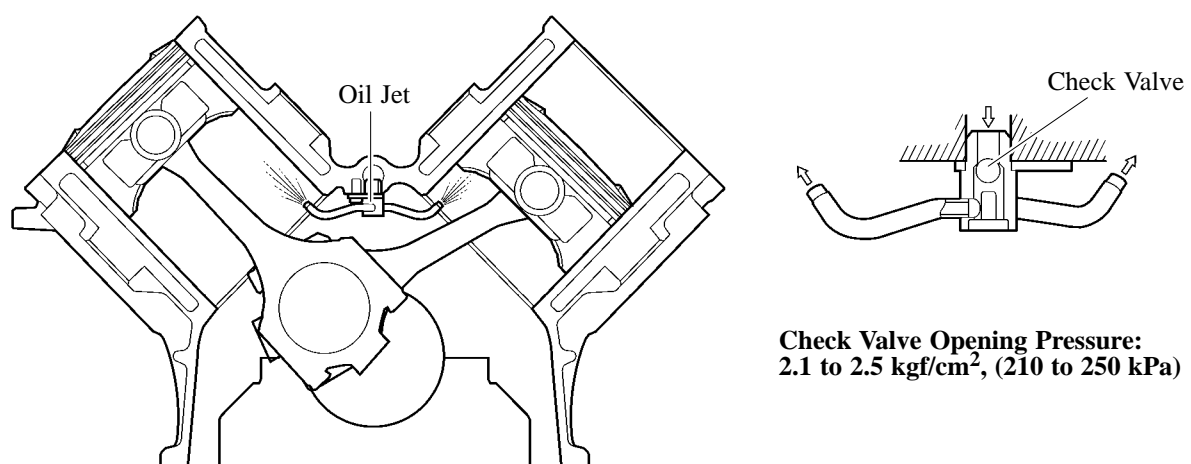
- A lead-free valve seat is used for environmental purposes.
- The air injection port is provided for the air injection system. For details, see page 172.



273GX76

Cylinder Block

- A lead-free crankshaft bearing is used for environmental purposes.
- Four oil jets for each piston are added. A check valve is built into an oil jet to stop oil injection when engine oil pressure is low, preventing engine oil pressure drop.

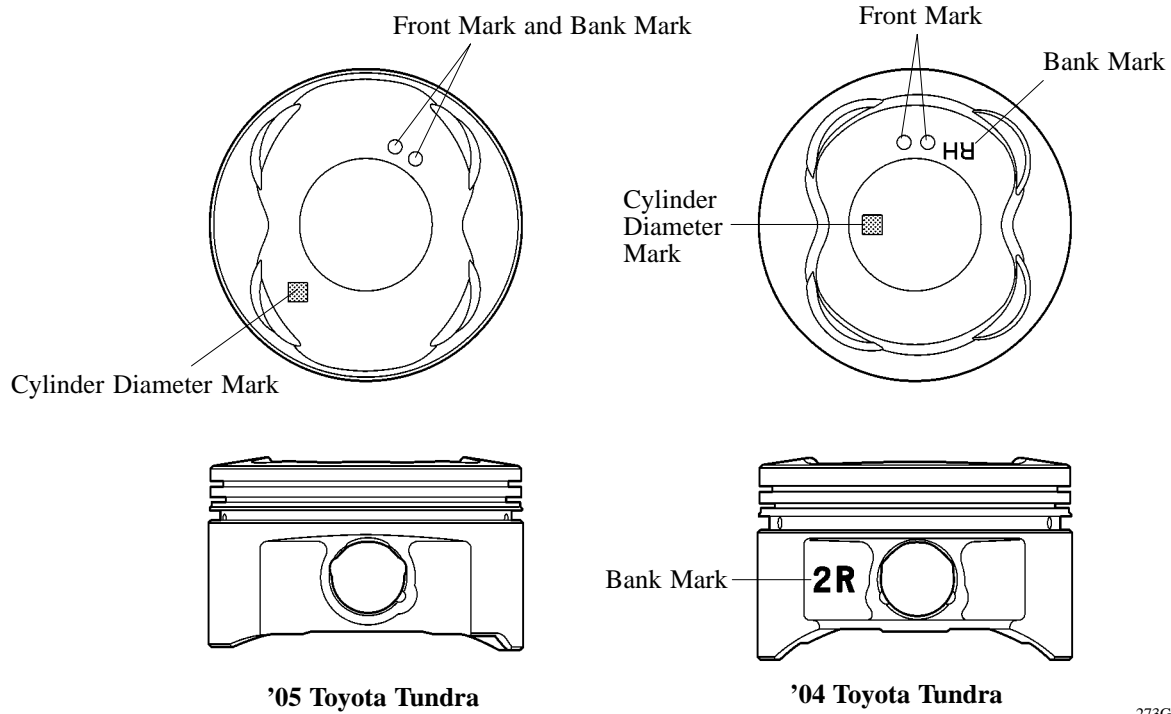


Check Valve Opening Pressure:
2.1 to 2.5 kgf/cm², (210 to 250 kPa)

273GX04

Piston

According to the compression ratio change, the piston shape is changed.

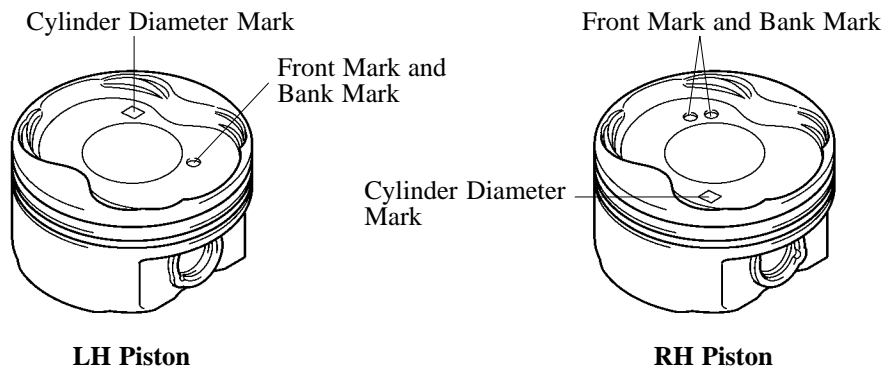


273GX61

Service Tip

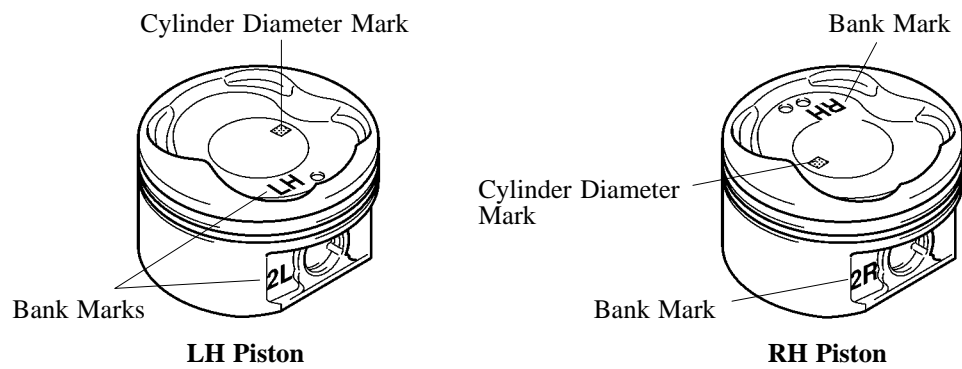
Cylinder diameter mark and bank mark are changed.

● '05 Toyota Tundra ◀



273GX62

● '04 Toyota Tundra ◀

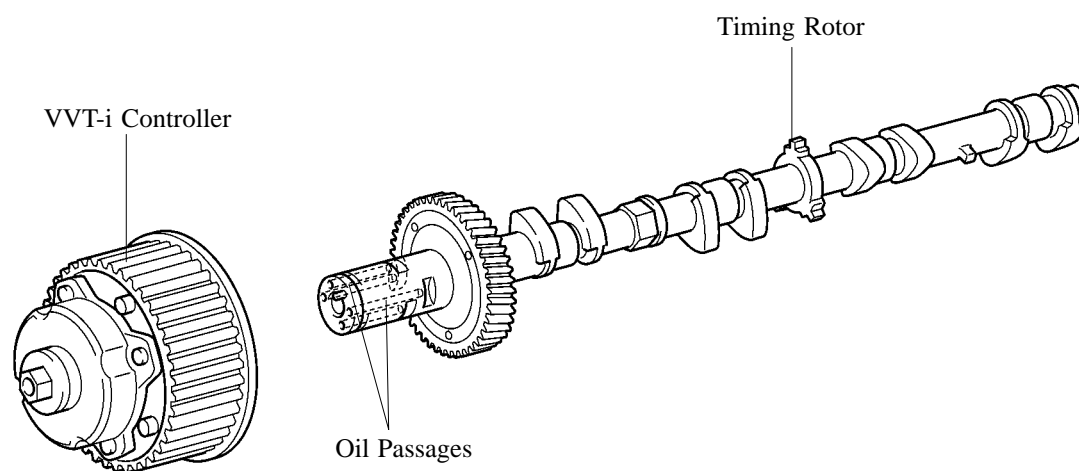


273GX63

4. Valve Mechanism

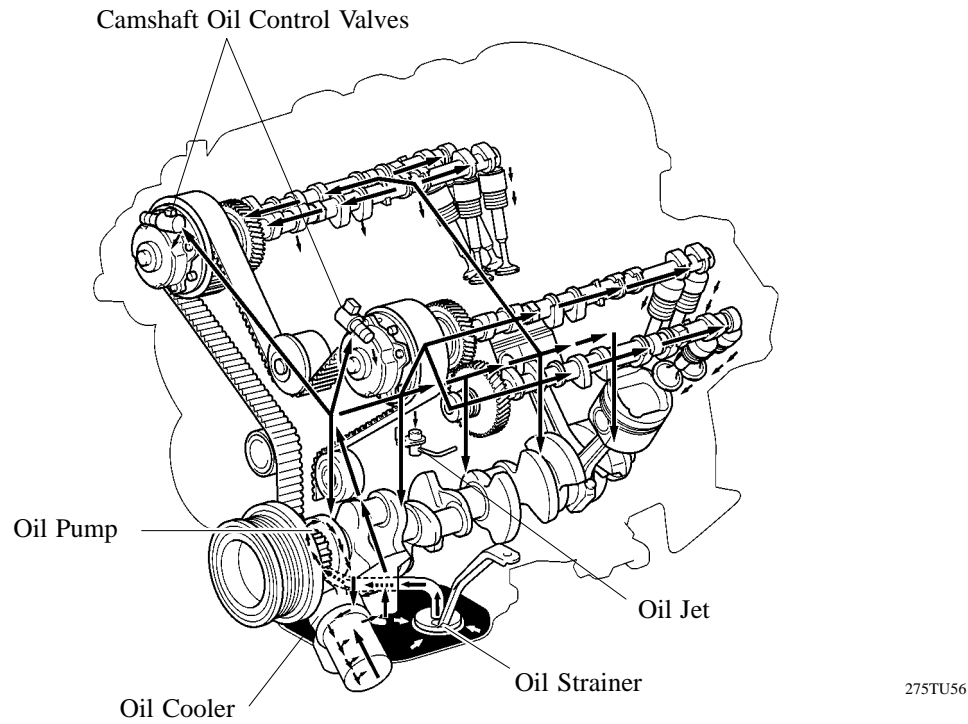
According to the addition of the VVT-i system, the intake camshaft is changed as follows.

- A VVT-i controller is installed on the front of the intake camshaft to vary the intake valve timing.
- A timing rotor for the VVT-i sensor is provided on the intake camshaft.
- An oil passage is provided in the intake camshaft in order to supply engine oil to the VVT-i controller.

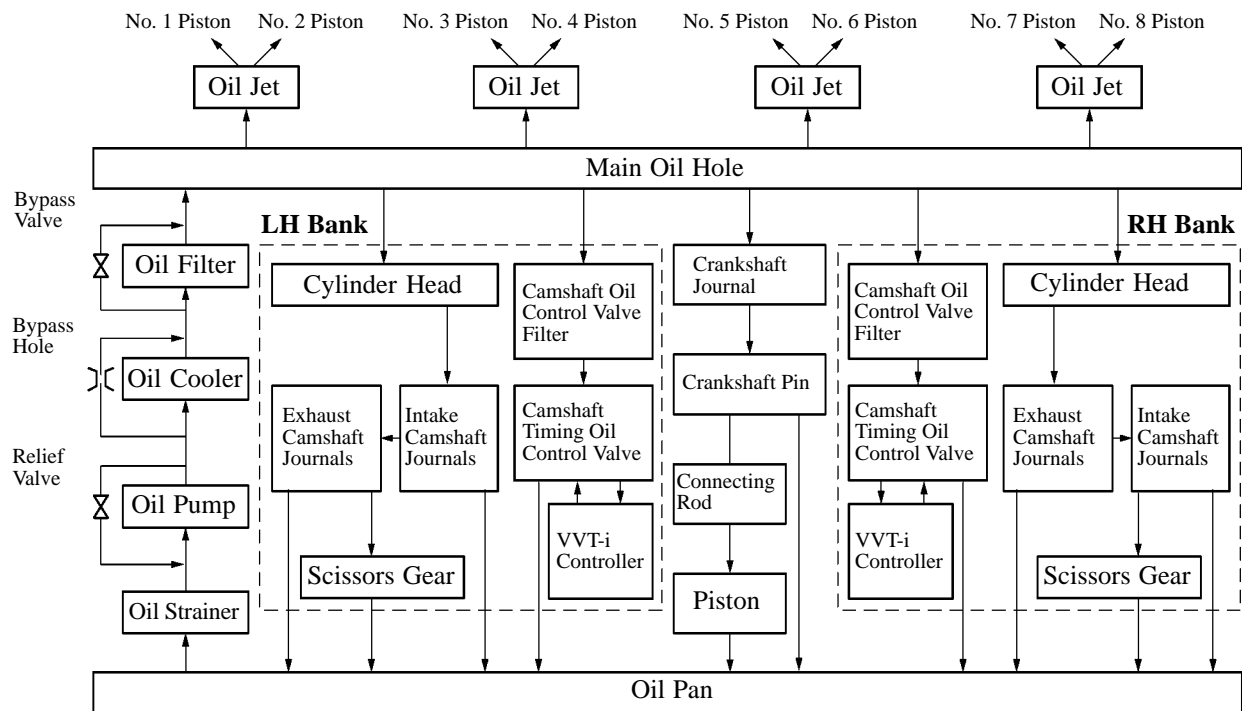


5. Lubrication System

According to the addition of the VVT-i system and four oil jets, the oil circuit is changed as follows.



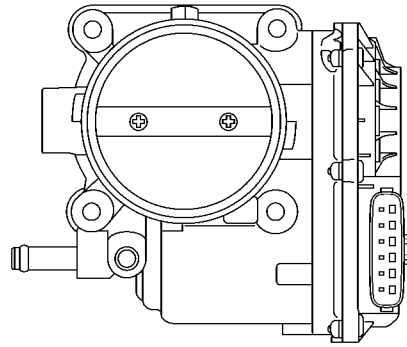
● Oil Circuit ◀



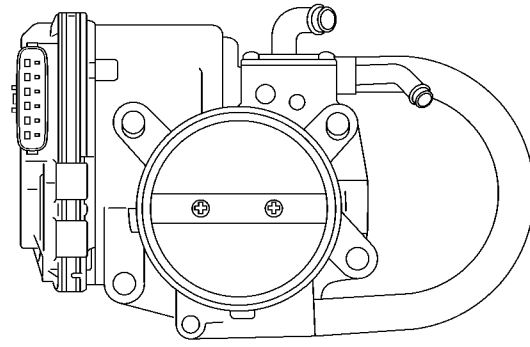
6. Intake and Exhaust System

Throttle Body

A lightweight and compact throttle body is used.



'05 Toyota Tundra

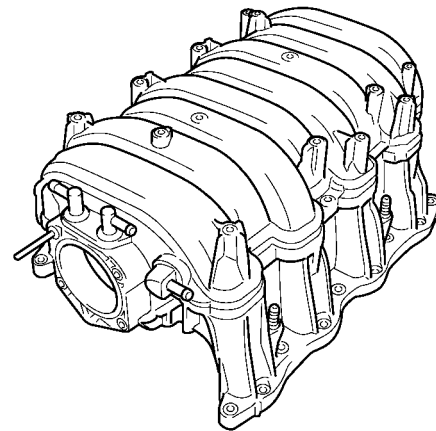


'04 Toyota Tundra

273GX07

Intake Manifold

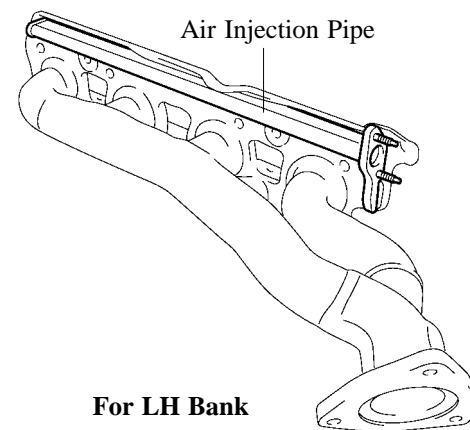
A plastic intake manifold is used for weight reduction.



273GX08

Exhaust Manifold

According to the addition of an air injection system, an air injection pipe is provided on the exhaust manifold.



For LH Bank

275TU91

7. Fuel System

For details, see page 118 in the 1GR-FE engine section.

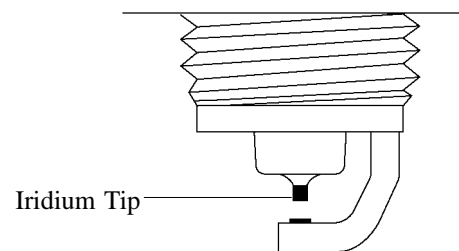
8. Ignition System

Spark Plug

The spark plug has been changed from conventional type spark plug to iridium-tipped spark plug. Iridium-tipped spark plugs have been adopted to realize a 120,000 mile (192,000 km) maintenance-free operation. The diameter of the center electrode has been reduced through the adoption of iridium, which excels in durability, thus improving ignition performance.

• Specifications ◀

DENSO made	SK20R11
NGK made	iFR 6A11
Plug Gap	1.0 - 1.1 mm (0.039 - 0.043 in.)



208EG70

9. Engine Control System

General

The engine control system of the 2UZ-FE engine on the '05 Toyota Tundra has following systems.

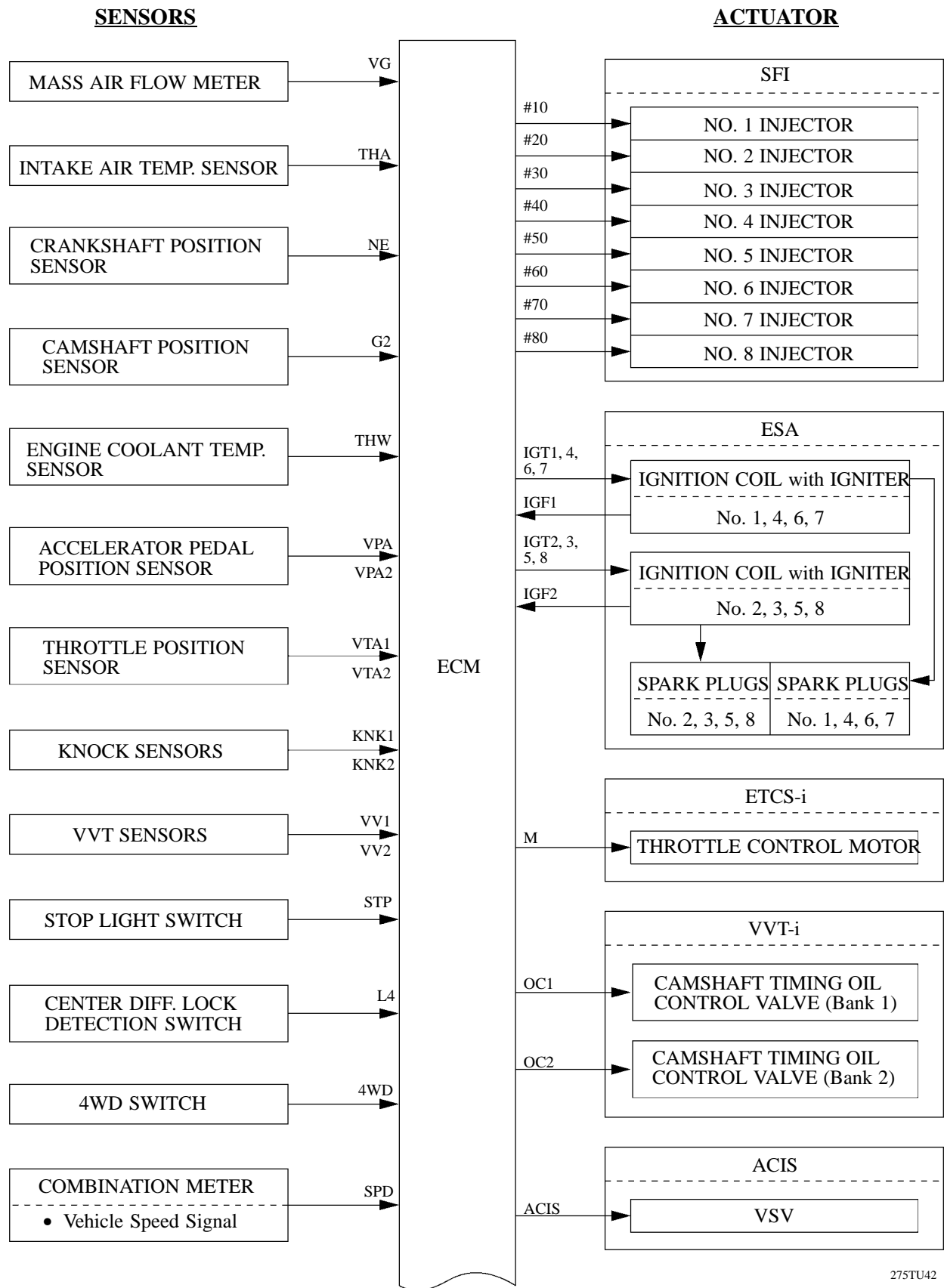
System	Outline	Model	
		'05 Toyota Tundra	'04 Toyota Tundra
SFI (Sequential Multiport Fuel Injection)	An L-type SFI system directly detects the intake air mass with a hot wire type mass air flow meter.	●	●
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on the signals from various sensors. The ECM corrects ignition timing in response to engine knocking.	●	●
ETCS-i (Electronic Throttle Control System-intelligent)	Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the conditions of the engine and the vehicle.	●	●
VVT-i (Variable Valve Timing-intelligent) [See page 166]	Controls the intake camshaft to ensure optimal valve timing in accordance with the engine condition.	●	—
ACIS (Acoustic Control Induction System) [See page 170]	The intake air passages are switched according to the engine speed and throttle valve opening angle to provide high performance in all speed ranges.	●	—
Air Injection [See page 172]	The ECM controls the air injection time based on the signals from the crankshaft position sensor, engine coolant temp. sensor, mass air flow meter and air pressure sensor.	●	—
Fuel Pump Control	<ul style="list-style-type: none"> The fuel pump speed is controlled by the signal from the ECM. The fuel pump is stopped when the SRS airbag is deployed in front, side or rear side collision. 	●	●
Starter Control (Cranking Hold Function)	Once the ignition switch is turned to the START position, this control continues to operate the starter until the engine starts.	●	●
Oxygen Sensor Heater Control	Maintains the temperature of the oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	—	●
Air Fuel Ratio Sensor and Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensor or oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	●	—
Evaporative Emission Control [See page 130]	The ECM controls the purge flow of evaporative emission (HC) in the charcoal canister in accordance with engine conditions.	●	●
	Using two VSVs and a vapor pressure sensor, the ECM detects any evaporative emission leakage occurring between the fuel tank and the charcoal canister through the changes in the tank pressure.	—	●
	Approximately five hours after the ignition switch has been turned OFF, the ECM operates the leak detection pump to detect any evaporative emission leakage occurring between the fuel tank and the charcoal canister through changes in the fuel tank pressure.	●	—

(Continued)

System	Outline	Model	
		'05 Toyota Tundra	'04 Toyota Tundra
Air Conditioning Cut-off Control	By turning the A/C compressor ON or OFF in accordance with the engine condition, drivability is maintained.	•	•
Diagnosis [See page 177]	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.	•	•
Fail-Safe	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.	•	•

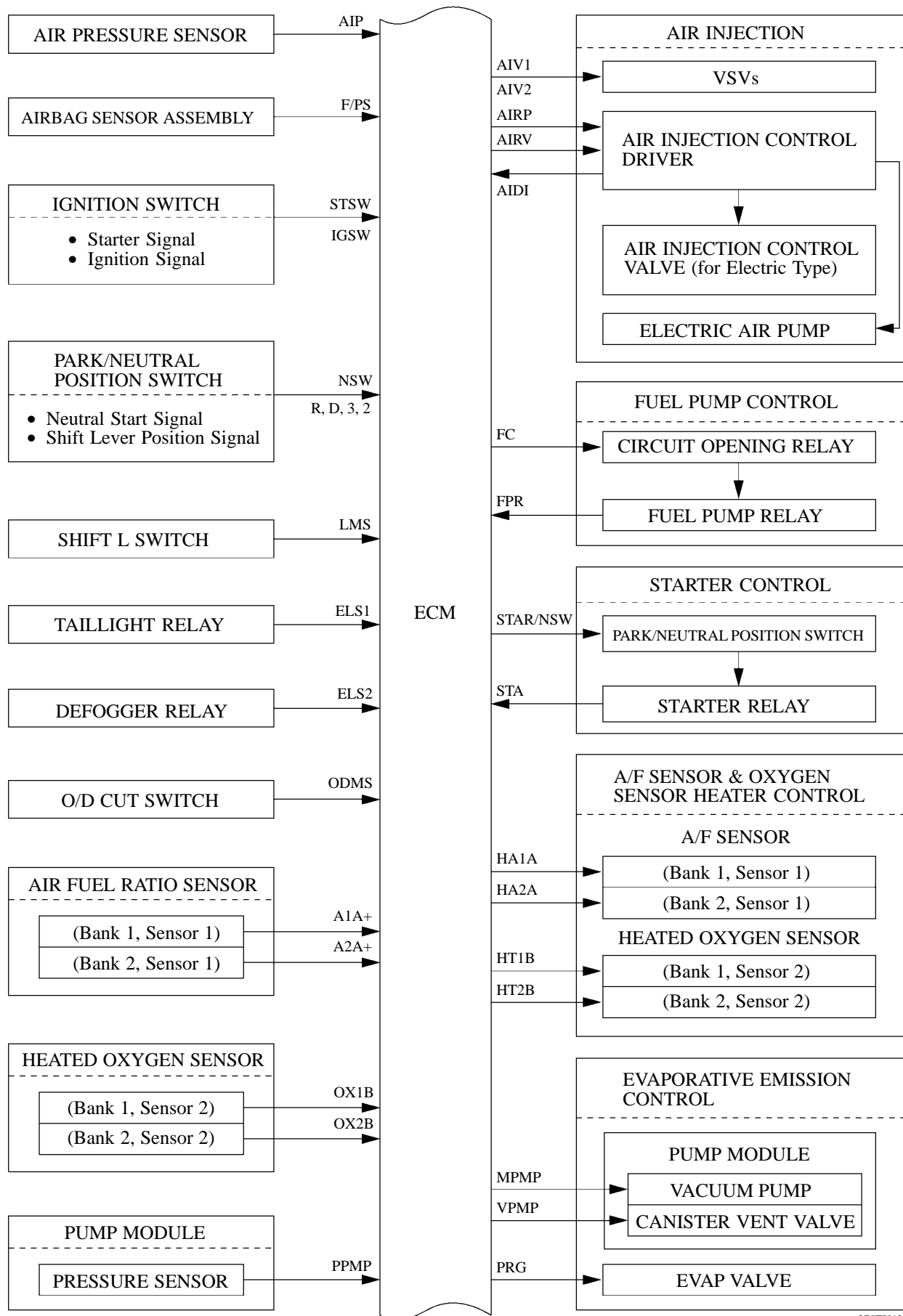
Construction

The configuration of the engine control system in the 2UZ-FE engine is shown in the following chart.



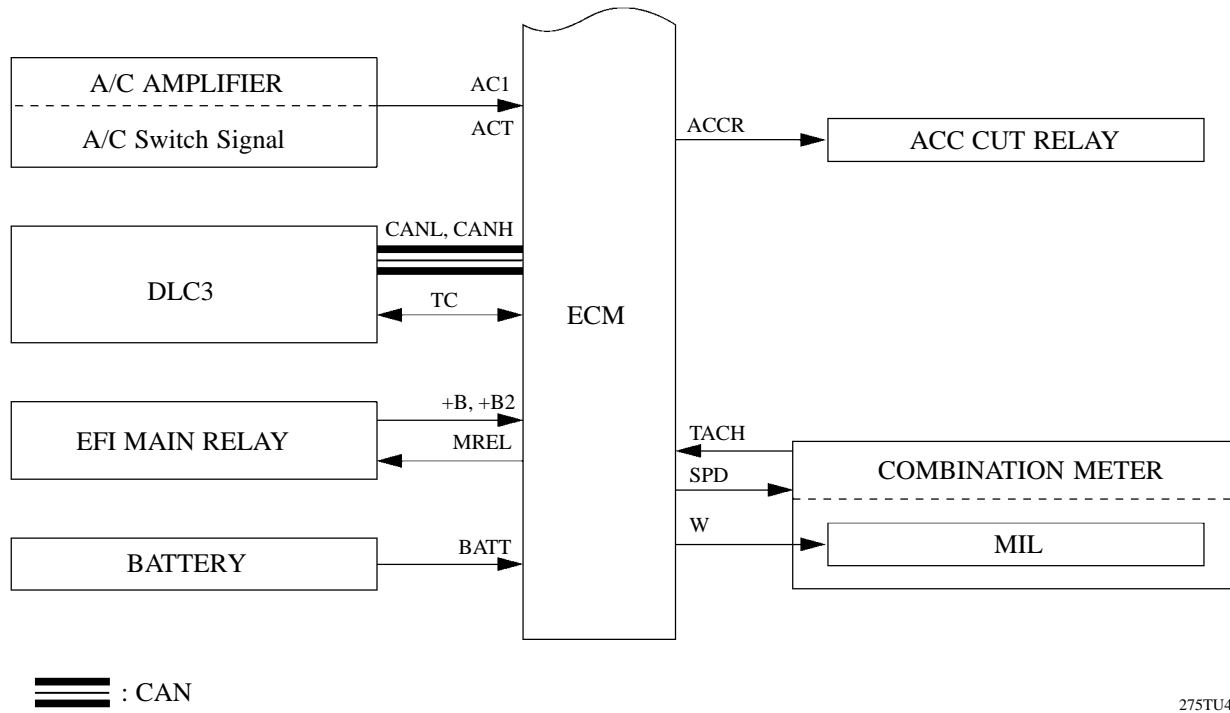
275TU42

(Continued)



275TU43

(Continued)



◀ 2UZ-FE ENGINE

Engine Control System

General

The engine control system of the 2UZ-FE engine on the '06 Toyota Tundra has following systems.

System	Outline	Model	
		'06 Toyota Tundra	'05 Toyota Tundra
SFI (Sequential Multiport Fuel Injection)	An L-type SFI system directly detects the intake air mass with a hot wire type mass air flow meter.	■	■
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on the signals from various sensors. The ECM corrects ignition timing in response to engine knocking.	■	■
ETCS-i (Electronic Throttle Control System-intelligent)	Optimally controls the throttle valve opening in accordance with the amount of accelerator pedal effort and the conditions of the engine and vehicle.	■	■
	An accelerator pedal position sensor is provided on the accelerator pedal	■	■
	A non-contact type throttle position sensor is used.	■	■
VVT-i (Variable Valve Timing-intelligent)	Controls the intake camshafts to ensure optimal valve timing in accordance with the engine condition.	■	■
ACIS (Acoustic Control Induction System)	The intake air passages are switched according to the engine speed and throttle valve opening angle to provide high performance in all speed ranges.	■	■
Air Injection	The ECM controls the air injection time based on the signals from the crankshaft position sensor, engine coolant temp. sensor, mass air flow meter and air pressure sensor.	■	■
Fuel Pump Control	The fuel pump speed is controlled by the signal from the ECM.	■	■
	The fuel pump is stopped when the SRS airbag is deployed in front, side or rear side collision.	■	■
Air Fuel Ratio Sensor and Oxygen Sensor Heater Control	Maintains the temperature of the air fuel ratio sensor or oxygen sensor at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	■	■
Evaporative Emission Control	The ECM controls the purge flow of evaporative emission (HC) in the canister in accordance with engine conditions.	■	■
	Approximately five hours after the ignition switch has been turned off, the ECM operates the canister pump module to detect any evaporative emission leakage occurring in the evaporative emission control system through changes in the reference orifice pressure.	■	■

(Continued)

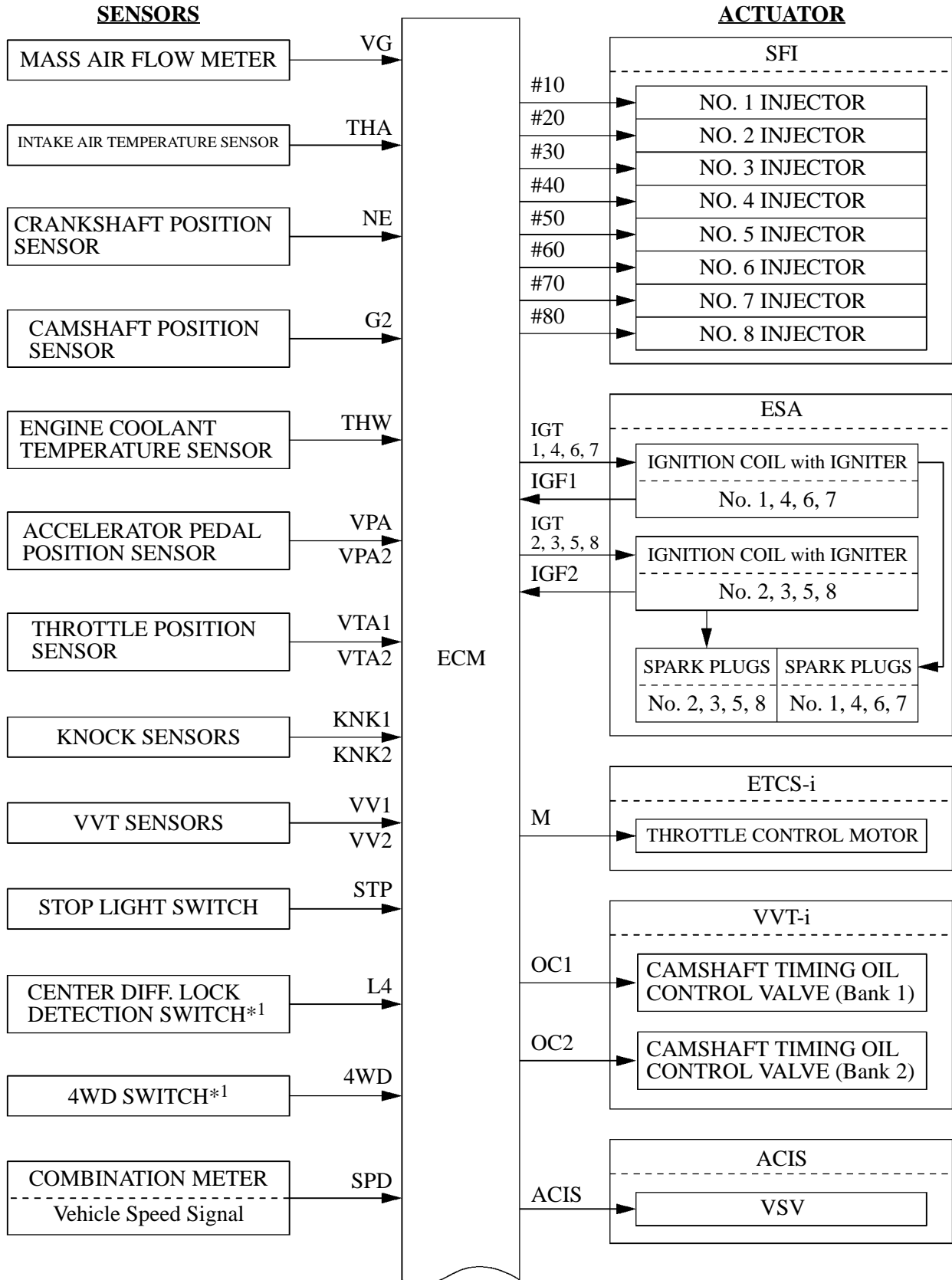
System	Outline	Model	
		'06 Toyota Tundra	'05 Toyota Tundra
Air Conditioning Cut-off Control*1	By turning the air conditioning compressor on or off in accordance with the engine condition, drivability is maintained.	■	■
Starter Control (Cranking Hold Function)	Once the ignition switch is turned to the START position, this control continues to operate the starter until the engine starts.	■	■
Engine Immobilizer*2	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.	■	—
Diagnosis	When the ECM detects a malfunction, the ECM diagnoses and memorizes the failed section.	■	■
Fail-safe	When the ECM detects a malfunction, the ECM stops or controls the engine according to the data already stored in the memory.	■	■

*1: for Models with Air Conditioning System

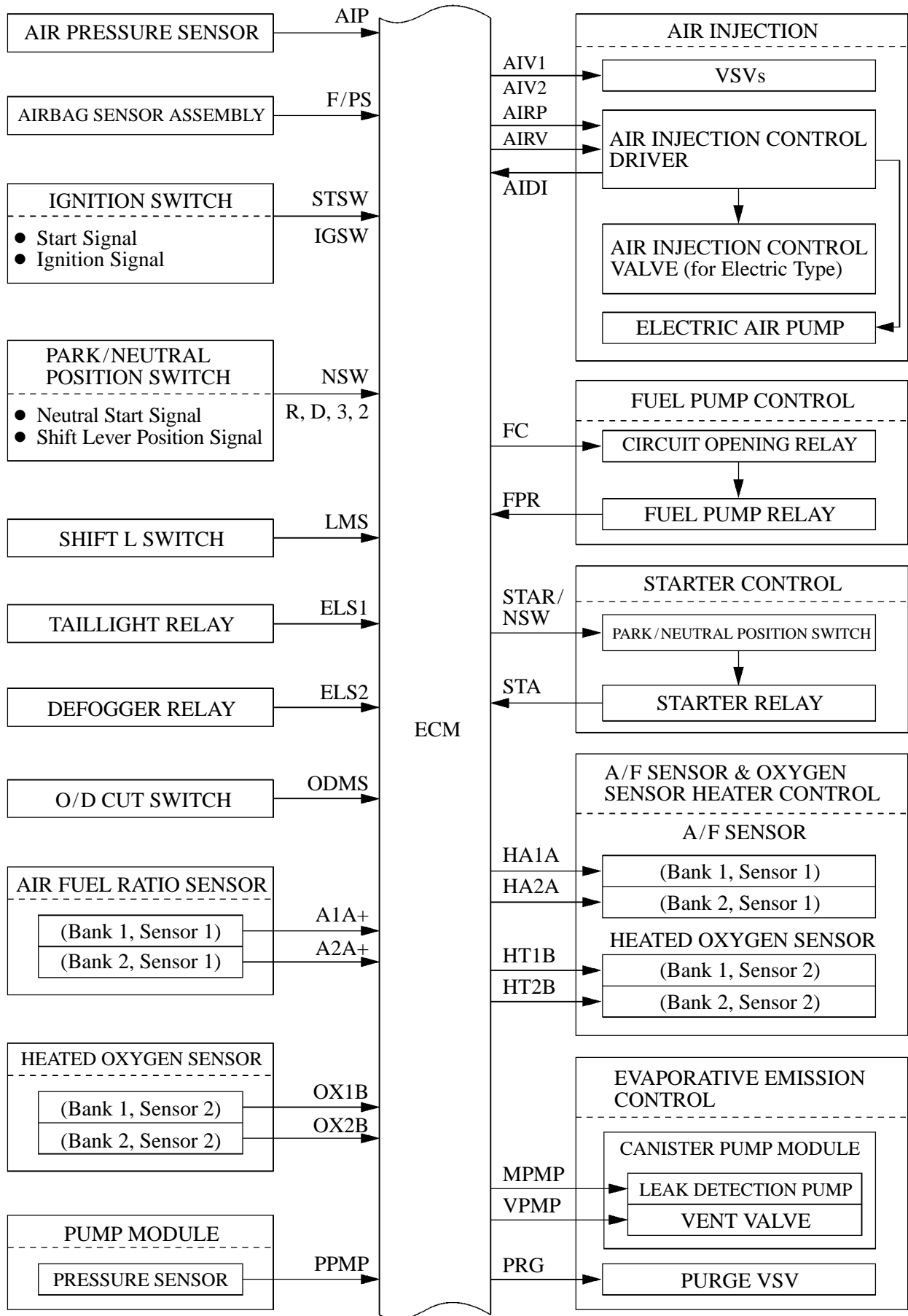
*2: Canada Models Only

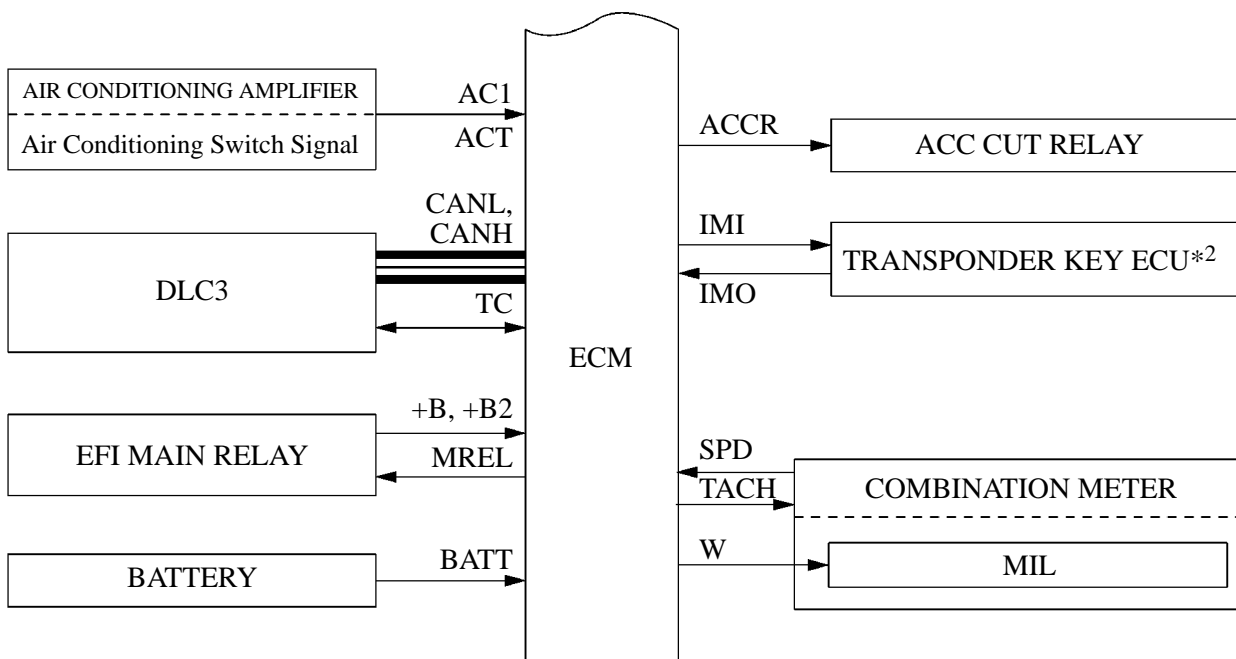
Construction

The configuration of the engine control system in the 2UZ-FE engine is shown in the following chart.



*1: 4WD Models





≡ : CAN

*2: Canada Models Only

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