2. New Features

NEW FEATURES

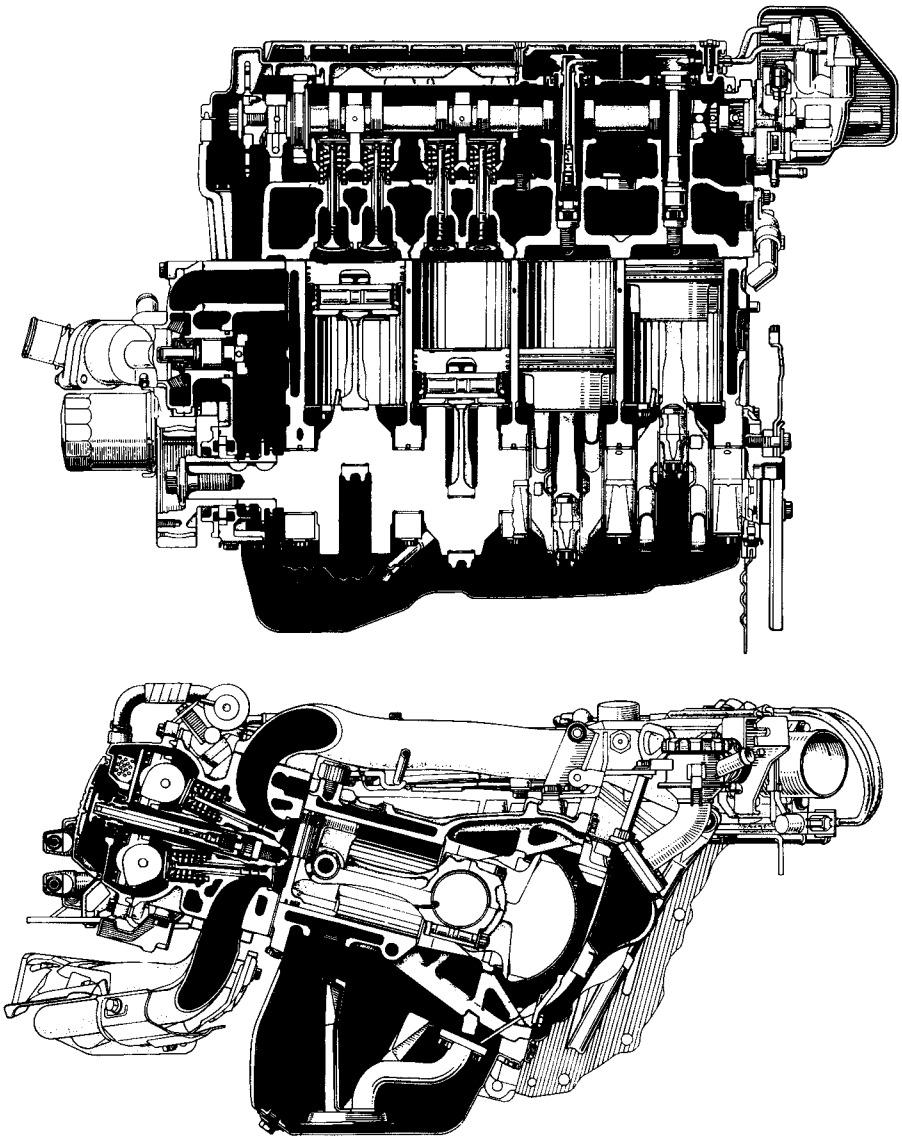
2TZ–FZE ENGINE

■ DESCRIPTION

The newly developed 2TZ–FZE engine is an in–line, 4–cylinder, 2.4–liter, 16–valve DOHC engine with a supercharger and charge air cooler [intercooler].

Although its basic construction and operation are the same as those in the 2TZ–FE engine of the current Previa, the Roots–type supercharger adopted by this engine offers increased power output, low fuel consumption, and high reliability. The supercharger is included in a separated accessory drive system.

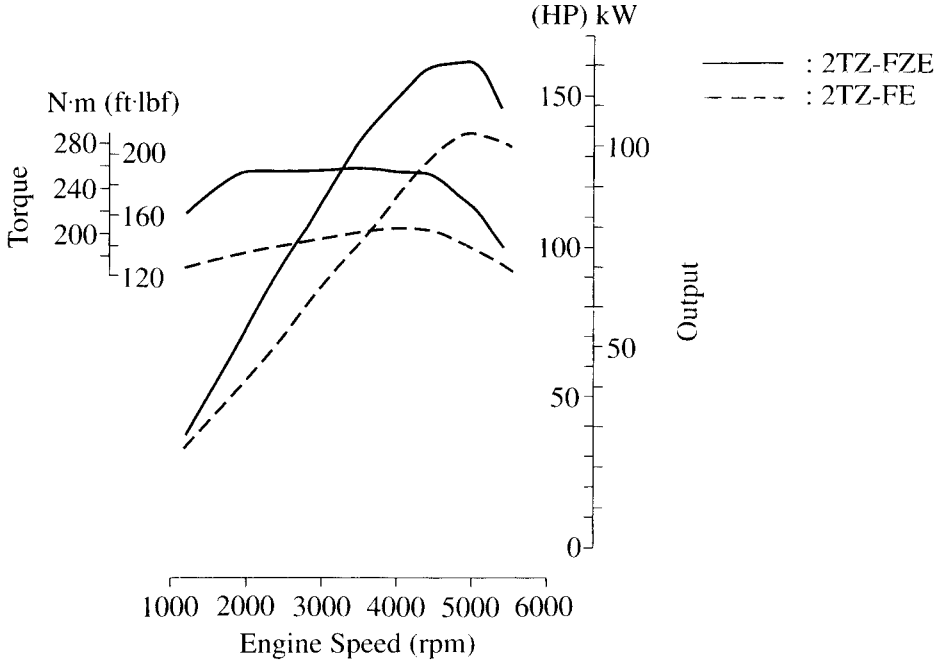
Features which distinguish the 2TZ–FZE engine from the 2TZ–FE engine will be explained in this section.



■ ENGINE SPECIFICATIONS AND PERFORMANCE CURVE

Item \ Engine Type			2TZ–FZE	2TZ–FE
No. of Cyls. & Arrangement			4–Cylinder, In–line	←
Valve Mechanism			16–Valve DOHC, Chain & Gear Drive	←
Combustion Chamber			Pentroof Type	←
Manifold			Cross–Flow	←
Fuel System			MFI*1 [EFI]	←
Displacement cm^3 (cu. in.)			2438 (148.8)	←
Bore x Stroke mm (in.)			95.0 x 86.0 (3.74 x 3.39)	←
Compression Ratio			8.9 : 1	9.3 : 1
Max. Output [SAE–NET]			120 kW @ 5000 rpm (161 HP @ 5000 rpm)	103 kW @ 5000 rpm (138 HP @ 5000 rpm)
Max. Torque [SAE–NET]			272 N·m @ 3600 rpm (201 ft·lbf @ 3600 rpm)	209 N·m @ 4000 rpm (154 ft·lbf @ 4000 rpm)
Valve Timing	Intake	Open	0° BTDC	10° BTDC
		Close	46° ABDC	44° ABDC
	Exhaust	Open	46° BBDC	40° BBDC
		Close	0° ATDC	6° ATDC
Fuel Octane Number RON			91 or Higher	←
Oil Grade			API SG, SH, EC–II, ILSAC*2 or Better	API SG, EC–II or Better

*1: MFI (Multiport Fuel Injection)
*2: ILSAC (International Lubricant Standardization and Approval Committee)



The above specifications and performance curves use premium unleaded gasoline (96 RON).

■ FEATURES OF 2TZ–FZE ENGINE

Features of the 2TZ–FZE engine are listed below.

Features	Contents
High Performance and Economy	• Higher power output and torque through the use of a Roots–type supercharger. • Air–cooled type charge air cooler [intercooler] to lower the intake air temperature. • Step motor type supercharger bypass valve to optimize the supercharger flow. • Piston with reduced friction. • Valve timing to improve fuel economy. • Hot–wire type mass air flow meter for accurate intake air volume measurement. • 2–group injection type MFI* [EFI] system.
Low Noise and Vibration	• Air cleaner and resonator of the supercharger outlet duct which reduce intake air noise. • Large capacity muffler.
Good Serviceability and High Reliability	• Exhaust valve seat with exceptional wear resistance. • Cylinder head gasket with excellent sealing performance. • Piston made of squeeze cast aluminum alloy with high temperature strength. • Oil jets for cooling the piston have been added. • Supercharger is included in the separated accessory drive system. • Diagnosis system which conforms to OBD–II.

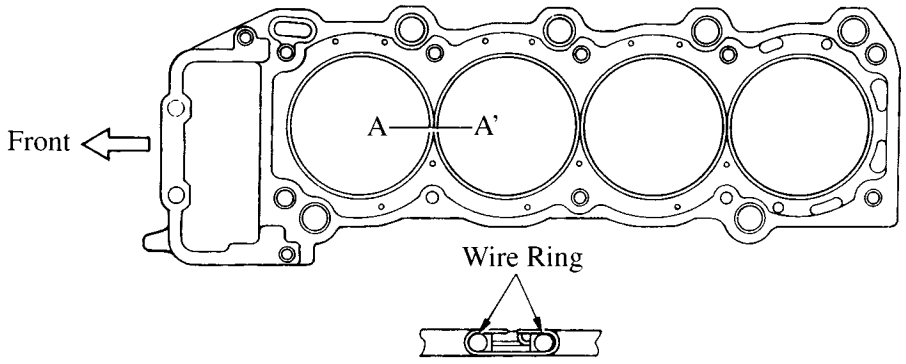
*: MFI (Multiport Fuel Injection)

■ ENGINE PROPER

1. Cylinder Head Gasket

Wire rings placed inside the bore grommets enables the cylinder head gasket to withstand the high combustion pressure and heat caused by supercharging.

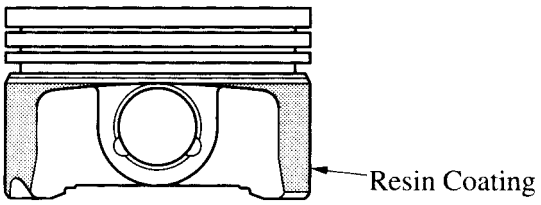
This further enhances pressure resistance, sealing performance, and reliability of the cylinder head gasket.



A – A' Cross Section

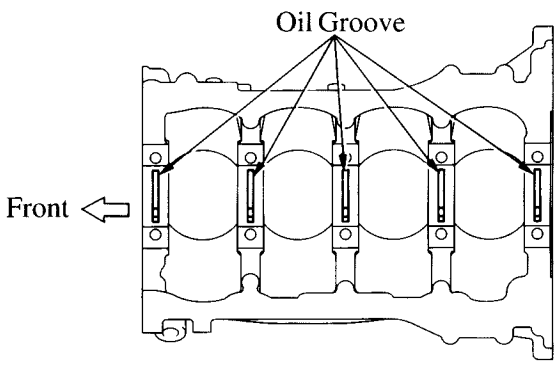
2. Piston

- Squeeze cast aluminum alloy with good high–temperature resistance is used.
- The friction between the piston and cylinder has been reduced. The piston skirt area has been shortened to make the piston lighter.
- The piston skirt area has been coated with resin for decreased friction characteristics.

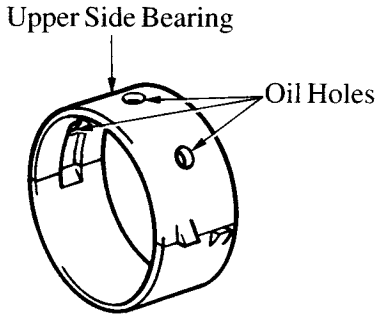


3. Crankshaft

The crankshaft of the 2TZ–FZE engine is the same as that of the 2TZ–FE engine. However, the cylinder block journals and the crankshaft upper side bearings have been provided with oil grooves and holes which increase the volume of oil supplied to the crankshaft in order to further improve its reliability.



Cylinder Block



Crankshaft Bearing

■ VALVE MECHANISM

1. General

The valve mechanism of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

However, the valve timing has been revised to best suit the 2TZ–FZE engine.

2. Valve Timing

The overlap between the closing of the exhaust valve and the opening of the intake valve has been set to 0°. This prevents the intake air–fuel mixture compressed by the supercharger from being expelled to the exhaust side and thus improves the fuel efficiency of the engine.

▶Specifications◀

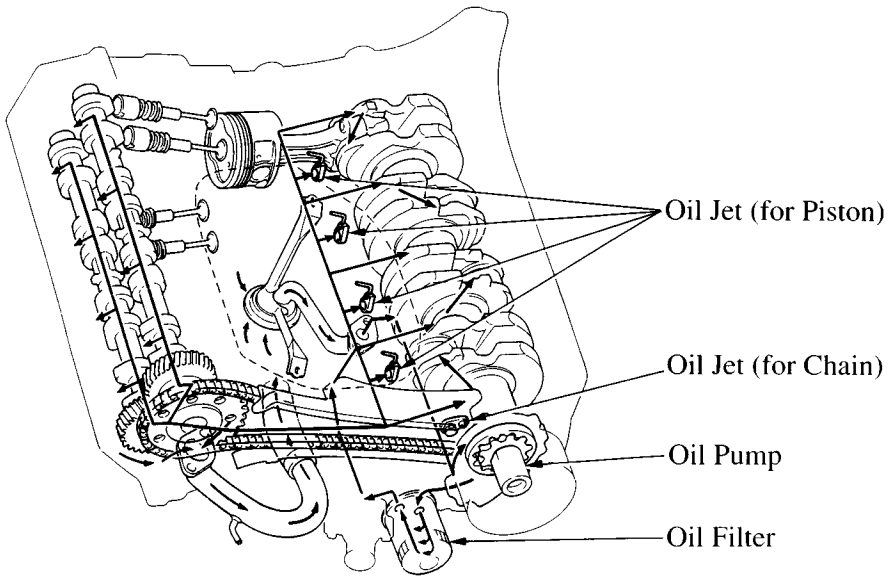
Engine Type / Valve Timing		2TZ–FZE	2TZ–FE
Intake	Open	0° BTDC	10° BTDC
	Close	46° ABDC	44° ABDC
Exhaust	Open	46° BBDC	40° BBDC
	Close	0° ATDC	6° ATDC

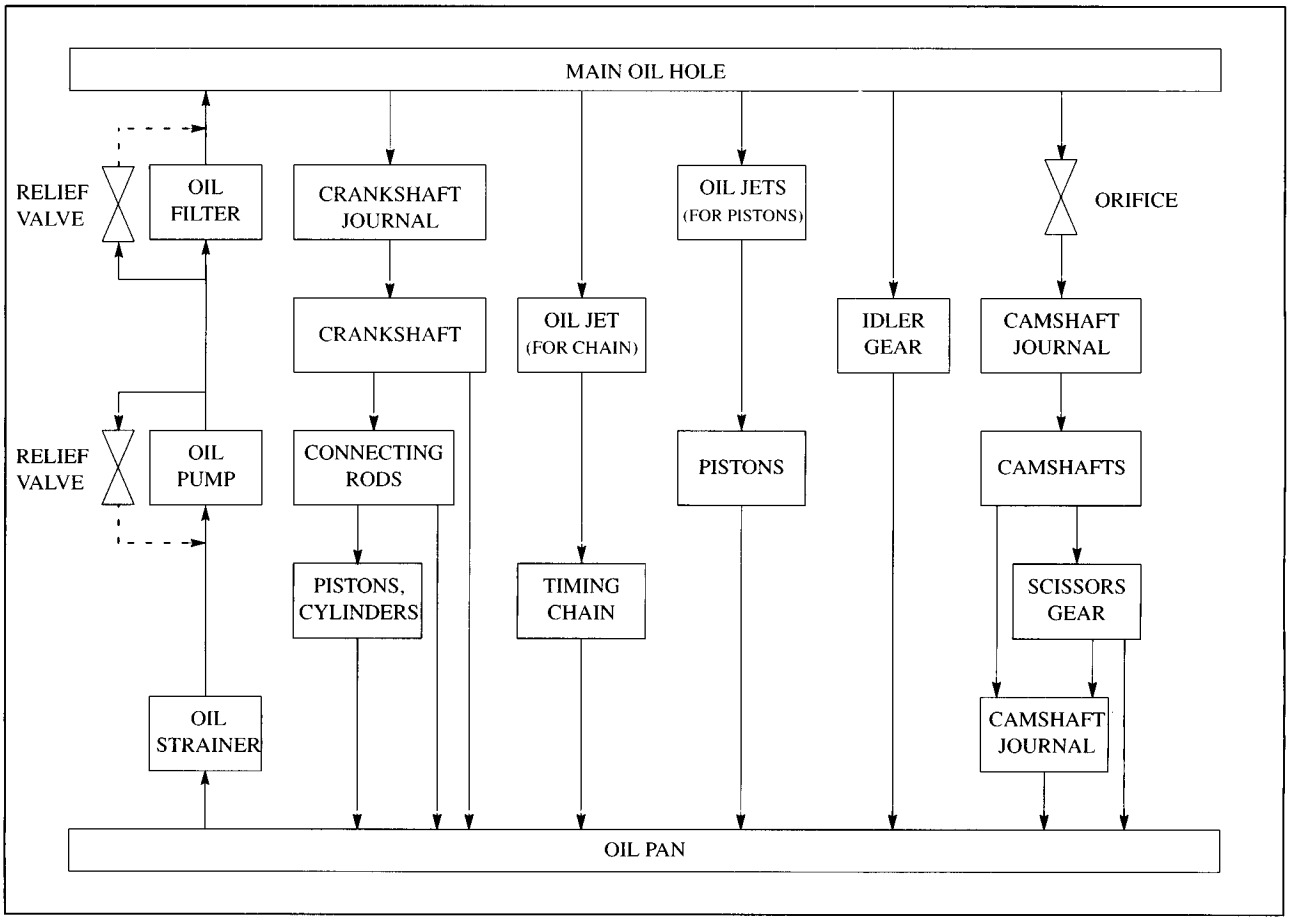
■ LUBRICATION SYSTEM

1. General

The lubrication system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

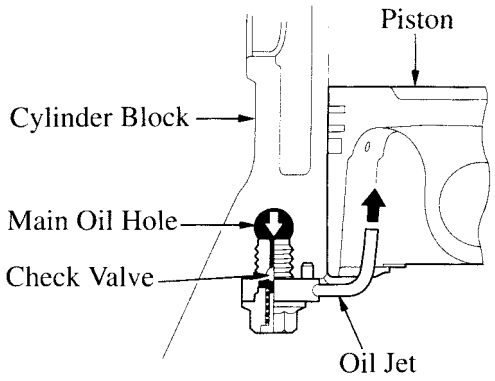
However, the cylinder block is provided with oil jets to help cool the piston. In conjunction with this change, the oil pump capacity and discharge rate have been increased.





2. Oil Jets (for Piston)

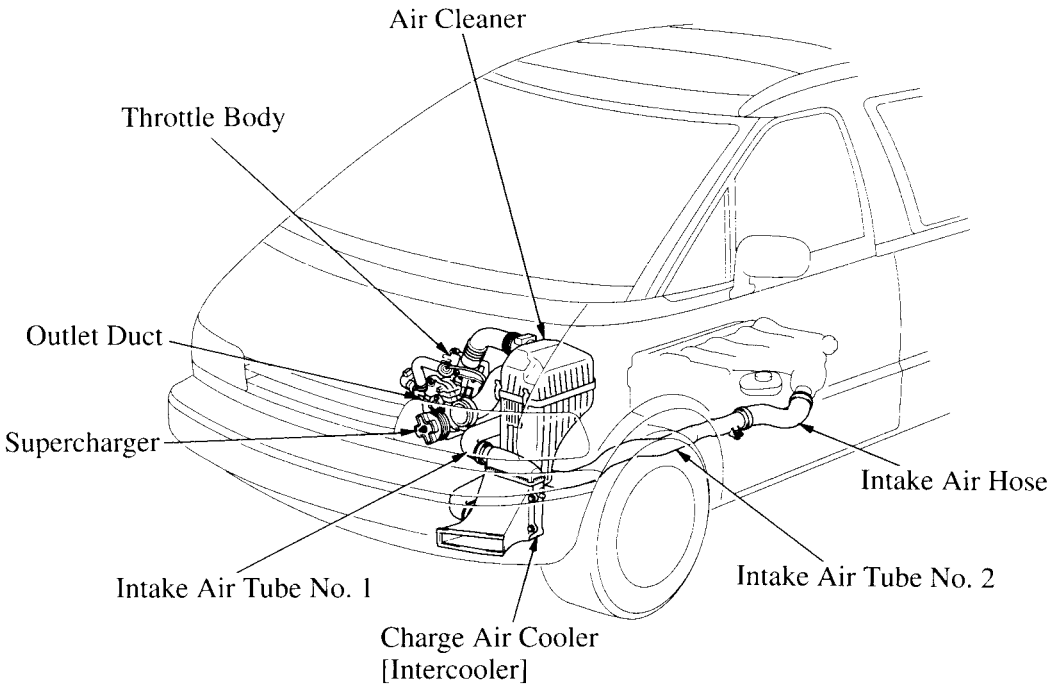
In the cylinder block, an oil jet is provided for each cylinder. As the oil pressure rises in accordance with the increase in engine speed, the oil at the main oil hole overcomes the check valve. This allows the oil jet to spray oil into the piston interior from the direction of the connecting rod to cool the piston.



■ INTAKE AND EXHAUST SYSTEM

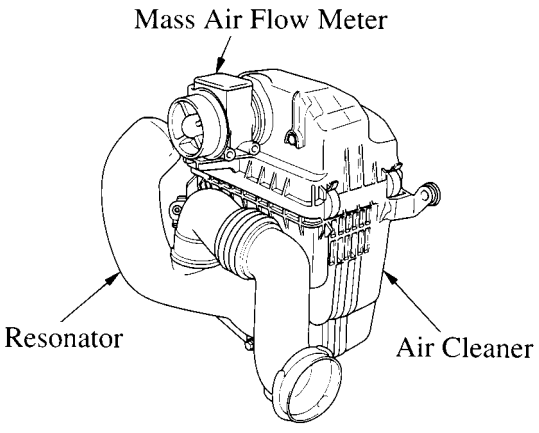
1. General

The intake system of the 2TZ–FZE engine is as follows:



2. Air Cleaner

- A mass air flow meter is directly attached to a large–capacity air cleaner to increase the intake air efficiency.
- A side branch type resonator is used to reduce intake air noise.



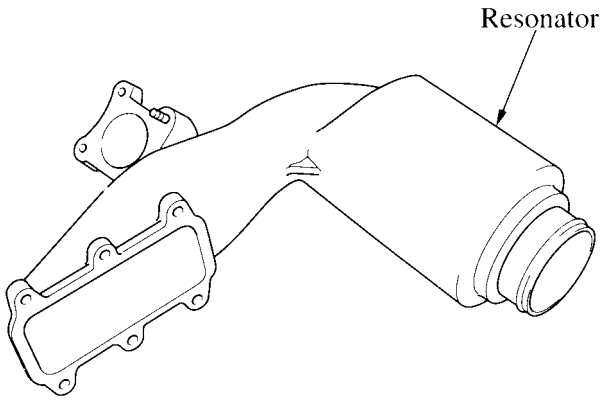
3. Throttle Body

The throttle body of the 2TZ–FZE engine is the same as that of the 2TZ–FE engine, except the following areas:

- In conjunction with the increase in the intake air volume because of the addition of the supercharger, the inner diameter of the throttle body has been enlarged and the throttle body positioned at the front of the vehicle, downstream from the mass air flow meter.
- The TVV [BVSV] has been discontinued along with the change in the EGR system.

4. Outlet Duct

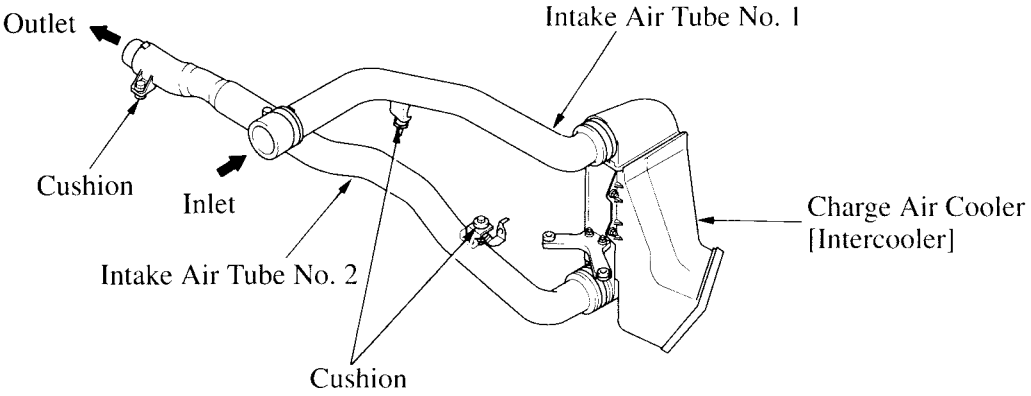
To reduce intake air noise, the supercharger outlet duct with an integrated resonator has been developed using lightweight and compact aluminum.



5. Intake Air Tube No. 1 and No. 2

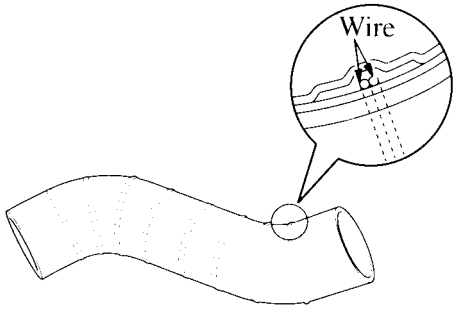
No. 1 and No. 2 intake air tubes made of molded resin, which feature lightweigt and pressure resistant performance, are used on the inlet and outlet sides of the charge air cooler [intercooler], respectivly.

In order to reduce the intake air noise, the tube shape has been optimally designed and cushions have been provided at the the locations where the tubes mount onto the body.



6. Intake Air Hose

The intake air hose with internal wire support offers excellent pressure resistance. Also, the wall thickness of the hose has been optimally designed to reduce the intake air noise.



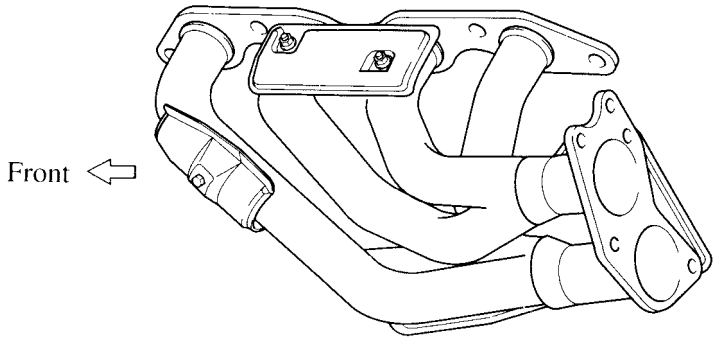
7. Intake Manifold

The intake manifold of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

However, the path of the EGR gas has been partially changed in accordance with the changes in the EGR system.

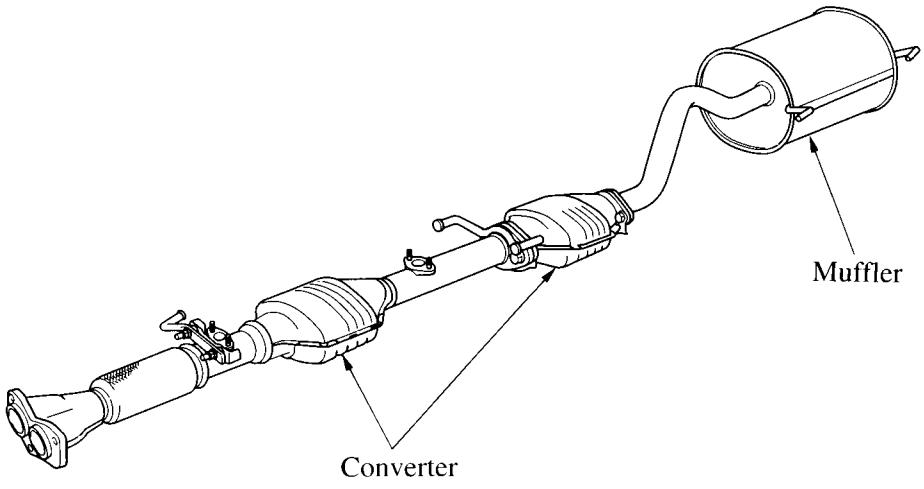
8. Exhaust Manifold

A stainless steel (SUS) dual exhaust manifold with optimally designed shape, length, and width has been adopted to increase the exhaust gas efficiency and to reduce weight.



9. Exhaust Pipe

- The exhaust pipe diameter has been enlarged to increase the exhaust gas efficiency.
- A high–capacity muffler is used to suppress exhaust noise.
- The 2 catalytic converters are monolithic type three–way catalytic converters.



■ SUPERCHARGER SYSTEM

1. General

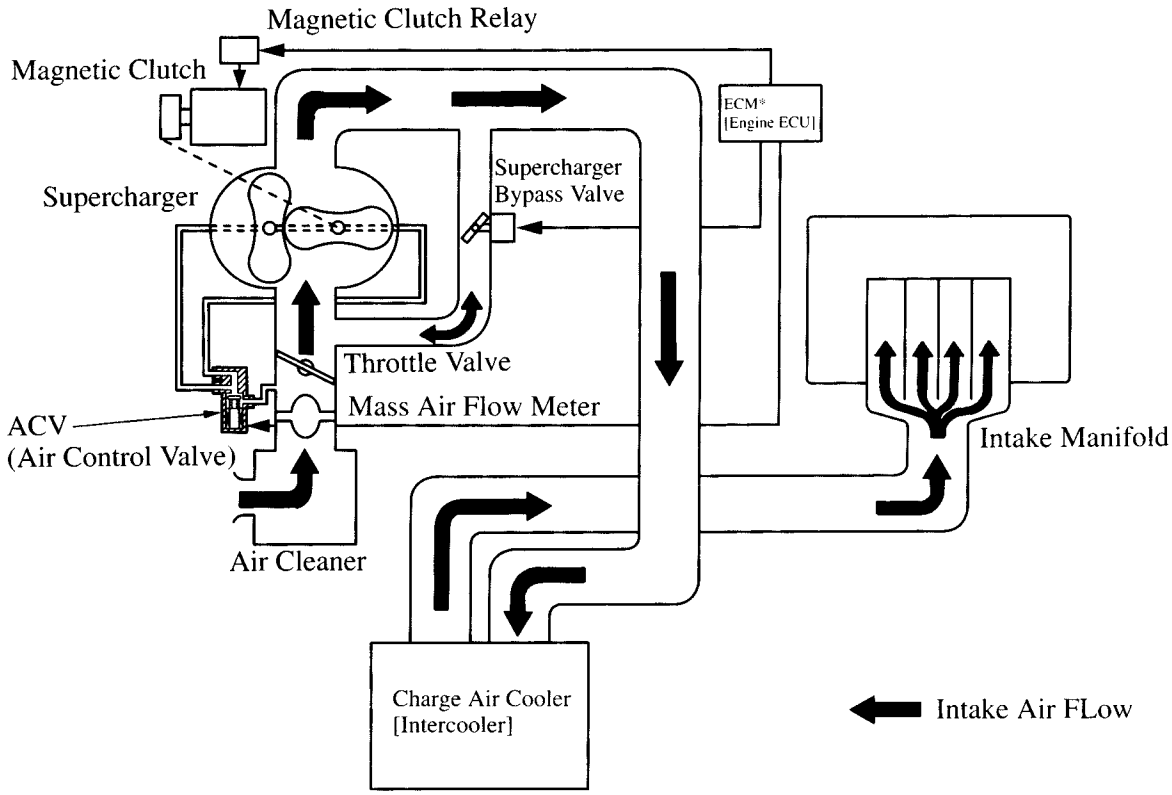
The supercharger is a device which increases the engine power output by introducing compressed air into the cylinders.

On the 2TZ–FZE engine, the drive power of the crankshaft, via the separate accessory drive shaft, is transmitted through a V–ribbed belt to the supercharger. This produces an excellent power response and generates high torque even in the low rpm ranges.

In accordance with the running condition of the engine, the signals from the ECM* [engine ECU] control the operation of the magnetic clutch, supercharger bypass valve, and ACV (Air Control Valve).

This supercharger system has the same basic construction and operation as in the 4A–GZE engine in the previous MR2 (AW11 series). For details, see the ’88 Model New Car Features (Pub. No. NCF024U), pages 38 to 45.

▶System Diagram◀



*: ECM (Engine Control Module)

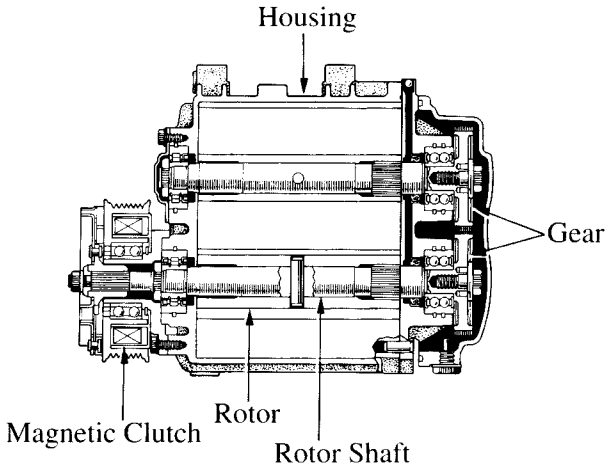
2. Supercharger

The supercharger of the 2TZ–FZE engine has the same basic construction and operation as in the 4A–GZE engine in the previous MR2.

However, a large capacity supercharger has been adopted to accommodate the larger cylinder displacement.

▶Specifications◀

Engine Type / Item	2TZ–FZE	4A–GZE
Ideal Discharge Rate (1/rev)	1.42	1.20
Weight	10.5 kg (25.4 lb.)	10.8 kg (23.8 lb.)
Pulley Efficiency	1.4	1.21
Oil Capacity	130 cm^3 (4.40 fl. oz.)	←
Type of Oil	Toyota Supercharger Oil or Equivalent	←



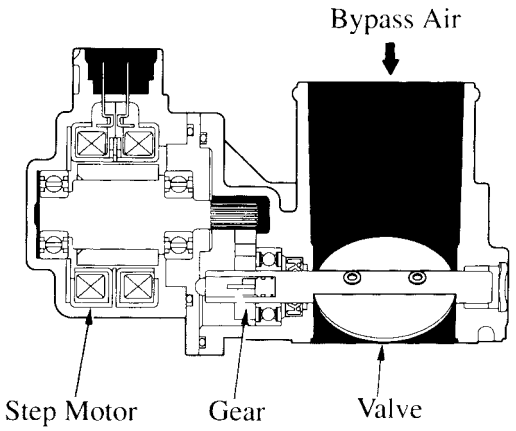
3. Supercharger Bypass Valve

The supercharger discharge rate is regulated by a step motor type bypass valve which controls the amount of air that bypasses the supercharger.

The step motor type supercharger bypass valve consists of a step motor, which is under direct control of the ECM* [engine ECU], and a valve that is driven by gears. In accordance with the running condition of the engine, the ECM* [engine ECU] controls the step motor to regulate the amount of intake air to bypass and thus optimize the supercharger discharge rate.

Compared to the 4A–GZE engine which uses a vacuum type supercharger bypass valve, the present 2TZ–FZE engine with the step motor type supercharger bypass valve can produce torque that is more linear in relation to the throttle opening angle.

*: ECM (Engine Control Module)

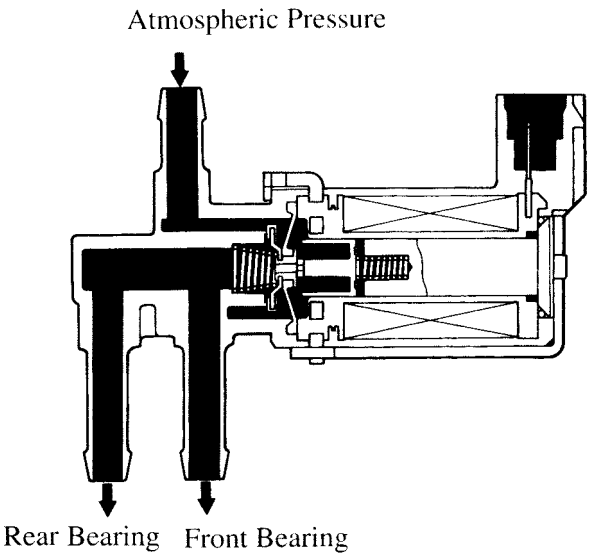


4. ACV (Air Control Valve)

In accordance with the signals received from the ECM* [engine ECU], the ACV brings the pressure at the front and rear bearings closer to the atmospheric pressure. This prevents the bearing grease and oil from leaking out due to pressure fluctuation inside the supercharger housing.

The ACV of the 2TZ–FZE engine has the same operation as in the 4A–GZE engine in the previous MR2.

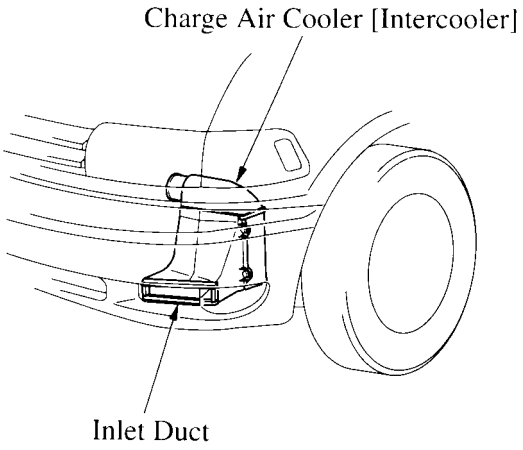
*: ECM (Engine Control Module)



5. Charge Air Cooler [Intercooler]

An air cooled type charge air cooler [intercooler] has been provided in the front part of the left front wheel housing.

To cool the intake air discharged by the supercharger, the charge air cooler [intercooler] uses the cool air introduced by the inlet duct located at the bottom of the bumper. This lowers the intake air temperature and increases the engine's power output.

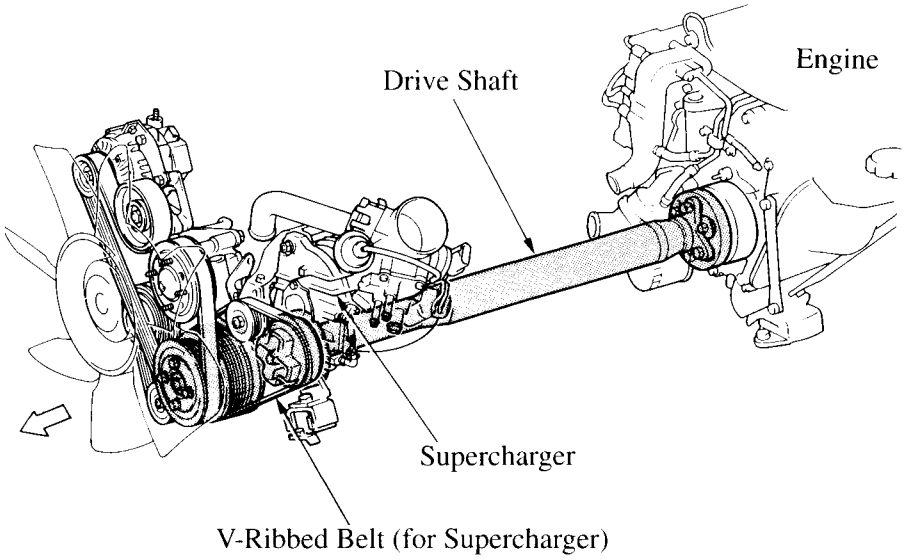


■ SEPARATED ACCESSORY DRIVE SYSTEM

1. General

The separated accessory drive system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

However, the supercharger and the V–ribbed belt which drives the supercharger are included as part of the accessory parts (which consists of the cooling fan, generator [alternator], power steering pump and air conditioning compressor), and their locations have been changed.



Accessory Parts

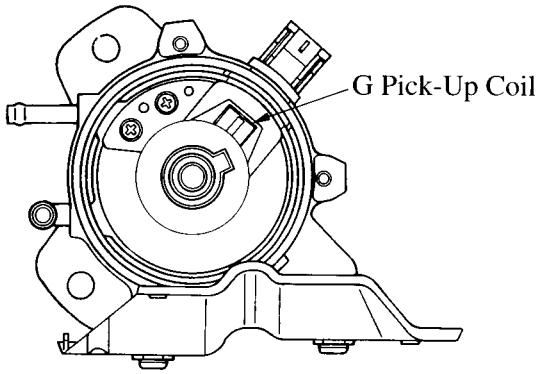
■ IGNITION SYSTEM

1. General

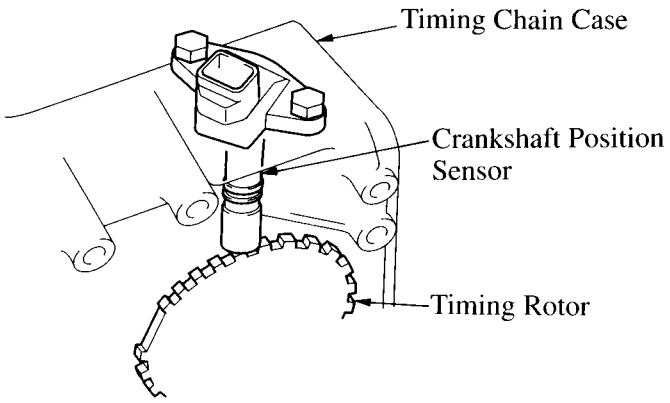
The ignition system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

However, the G pick–up coil is built into the distributor, and detects the camshaft angle signal [G signal]. The crankshaft position sensor is mounted on the timing chain case, and detects the engine speed and the crankshaft angle signals [Ne signal].

For the operation of the crankshaft position sensor, see the ’93 1/2 Toyota Supra New Car Features (Pub. No. NCF096U), page 109.



Distributor



Crankshaft Position Sensor

■ ENGINE CONTROL SYSTEM

1. General

The engine control system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

However, the 2TZ–FZE engine uses the 2–group type MFI*1 [EFI], in which the ECM*2 [engine ECU] controls the supercharger system, and uses a diagnosis system which conforms to OBD–II.

Comparison of the engine control system between the 2TZ–FZE engine and 2TZ–FE engine is as follows:

System	Outline	2TZ–FZE	2TZ–FE
MFI (Multiport Fuel Injection) [EFI]	An L–type MFI [EFI] system directly detects the intake air volume with a hot–wire type mass air flow meter.	○	—
	An L–type MFI [EFI] system directly detects the intake air volume with a vane type volume air flow meter.	—	○
	The fuel injection system is a 2–group type, each of which injects 2 cylinders simultaneously.	○	—
☞ Page 23	The fuel injection system is an all cylinders simultaneous injection type.	—	○
Cold Start Injector	When the coolant temperature is low, the injection duration of the cold start injector is controlled by the ECM*2 [engine ECU] and start injector time switch.	—	○
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM*2 [engine ECU] based on signals from various sensors. Corrects ignition timing in response to engine knocking.	○	○
☞ Page 23	Torque control correction during gear shifting has been used to minimize the shift shock.	○	—
IAC (Idle Air Control) [ISC] ☞ Page 24	A rotary solenoid type IAC [ISC] valve controls the fast idle and idle speeds.	○	○
Supercharger Control ☞ Page 24	ECM*2 [engine ECU] controls the operation of the magnetic clutch, supercharger bypass valve and ACV (Air Control Valve) in the supercharger system.	○	—
Fuel Pressure Control	In hot engine conditions, the fuel pressure is increased to improve restartability.	—	○
Fuel Pump Control ☞ Page 25	The fuel pump operates at 2 different speeds to reduce electrical power loss and improve the restartability in hot engine conditions.	○	—
Oxygen Sensor Heated Control	Maintains the temperature of the oxygen sensors at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	○	○

*1: MFI (Multiport Fuel Injection)
*2: ECM (Engine Control Module)

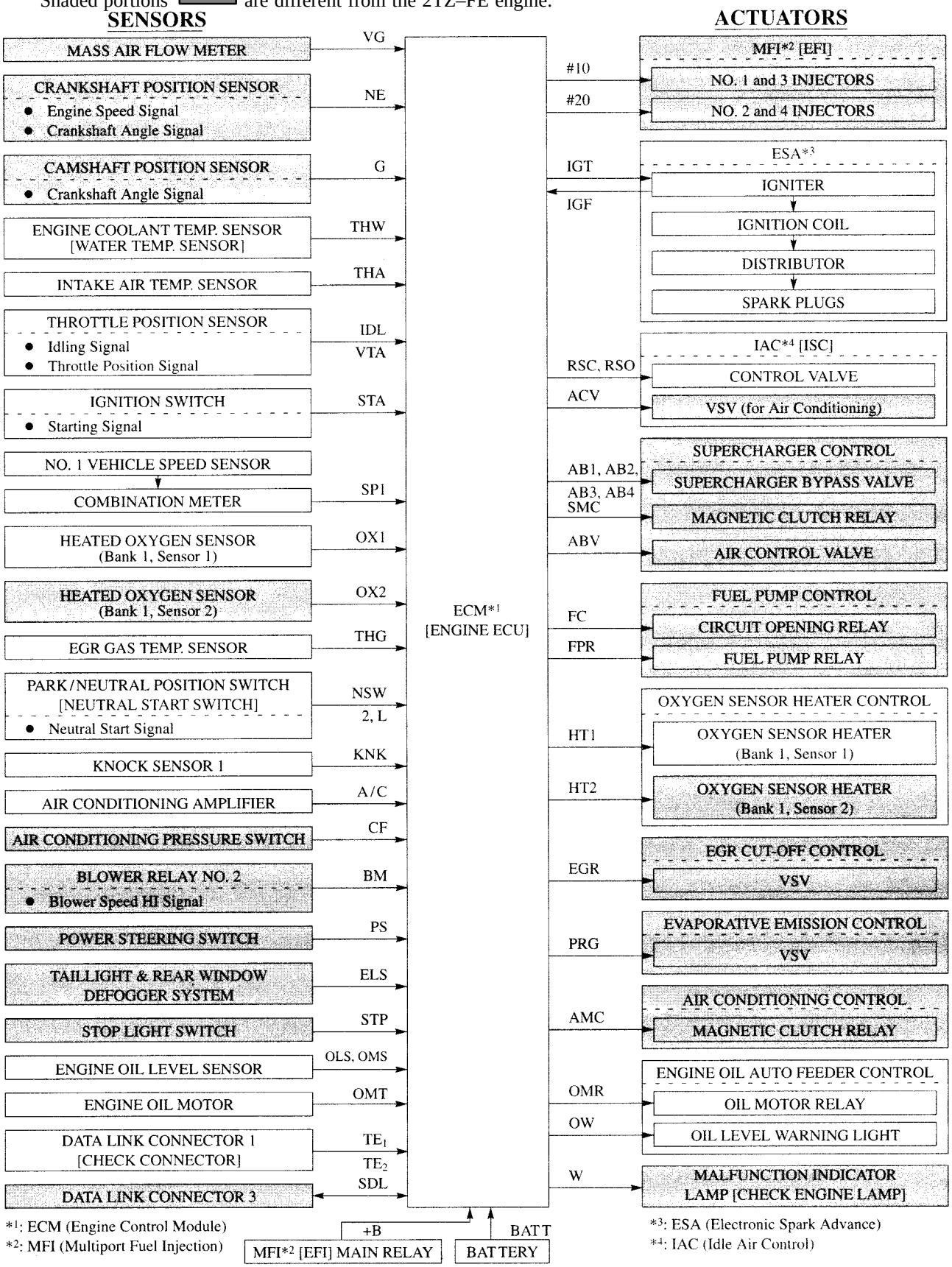
System	Outline	2TZ–FZE	2TZ–FE
EGR Cut–Off Control ☞ Page 25	The ECM*2 [engine ECU] controls the VSV of the EGR according to the engine condition to maintain drivability of the vehicle and durability of the EGR components.	○	—
Air Conditioning Control	ECM*2 [engine ECU] controls the air conditioning compressor ON or OFF in accordance with the engine condition.	○	—
☞ Page 25	The ECM*2 [engine ECU] transmits the air conditioning cut–off signal to the air conditioning amplifier in accordance with the engine condition.	—	○
Evaporative Emission Control ☞ Page 25	The ECM*2 [engine ECU] controls the purge flow of evaporative emissions (HC) in the charcoal canister in accordance with engine conditions.	○	—
Engine Oil Auto Feeder Control	The ECM*2 [engine ECU] senses the oil level in the oil pan through signals from the engine oil level sensor. It runs the motor to supply oil when the oil level is low, thus keeping the oil level constant.	○	○
Diagnosis	When the ECM*2 [engine ECU] detects a malfunction, the ECM*2 [engine ECU] diagnoses and memorizes the failed section.	○	○
☞ Page 25	The diagnosis system complies with OBD–II. The diagnosis items (the failed sections) are discriminated by connecting the Toyota hand–held tester to the newly designed data link connector 3.	○	—
Fail–Safe ☞ Page 26	When the ECM*2 [engine ECU] detects a malfunction, the ECM*2 [engine ECU] stops or controls the engine according to the data already stored in memory.	○	○

*2: ECM (Engine Control Module)

2. Construction

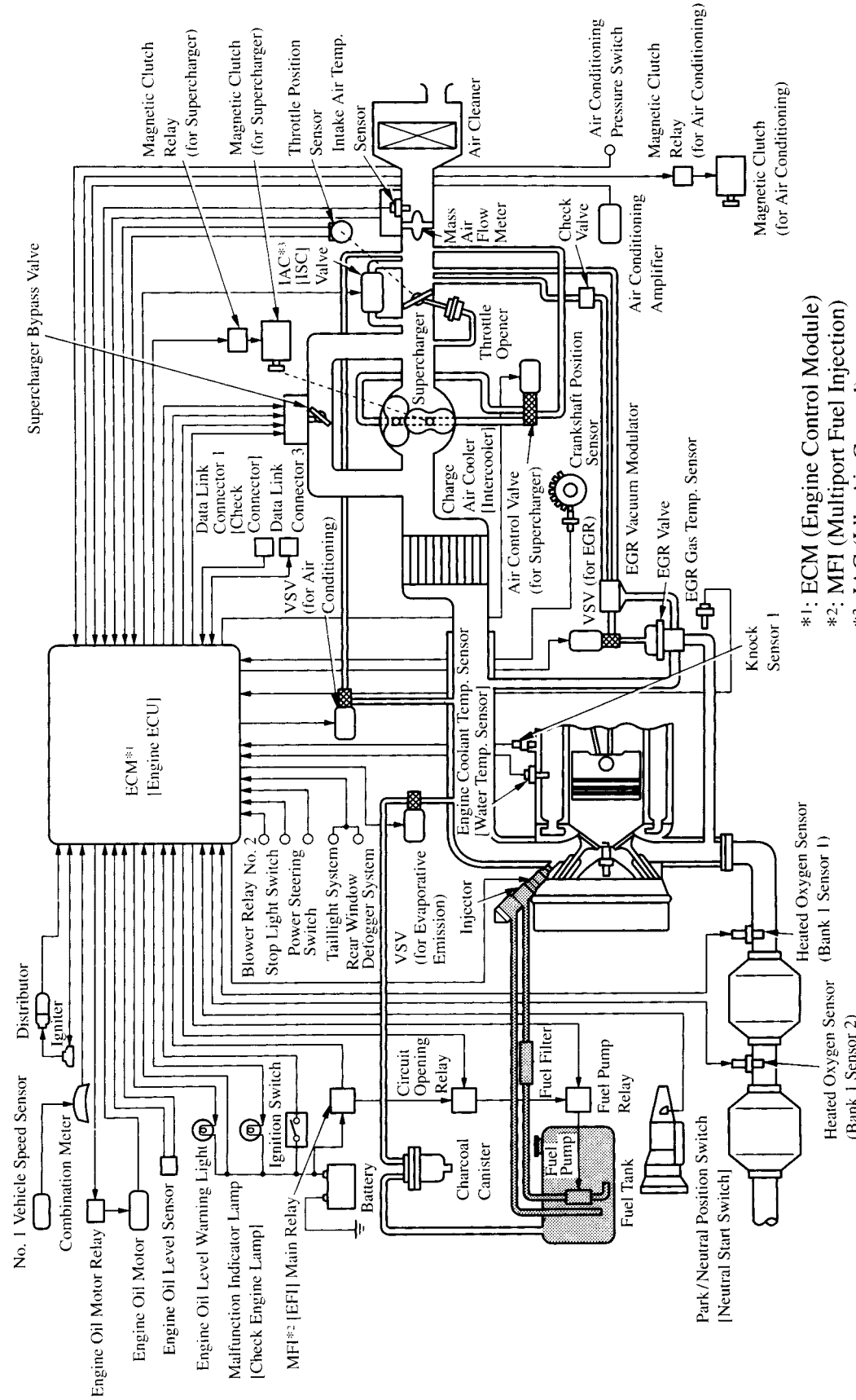
The configuration of the engine control system can be broadly divided into 3 groups: the ECM*1 [engine ECU], the sensors and the actuators, as shown in the following chart.

Shaded portions ▭ are different from the 2TZ–FE engine.

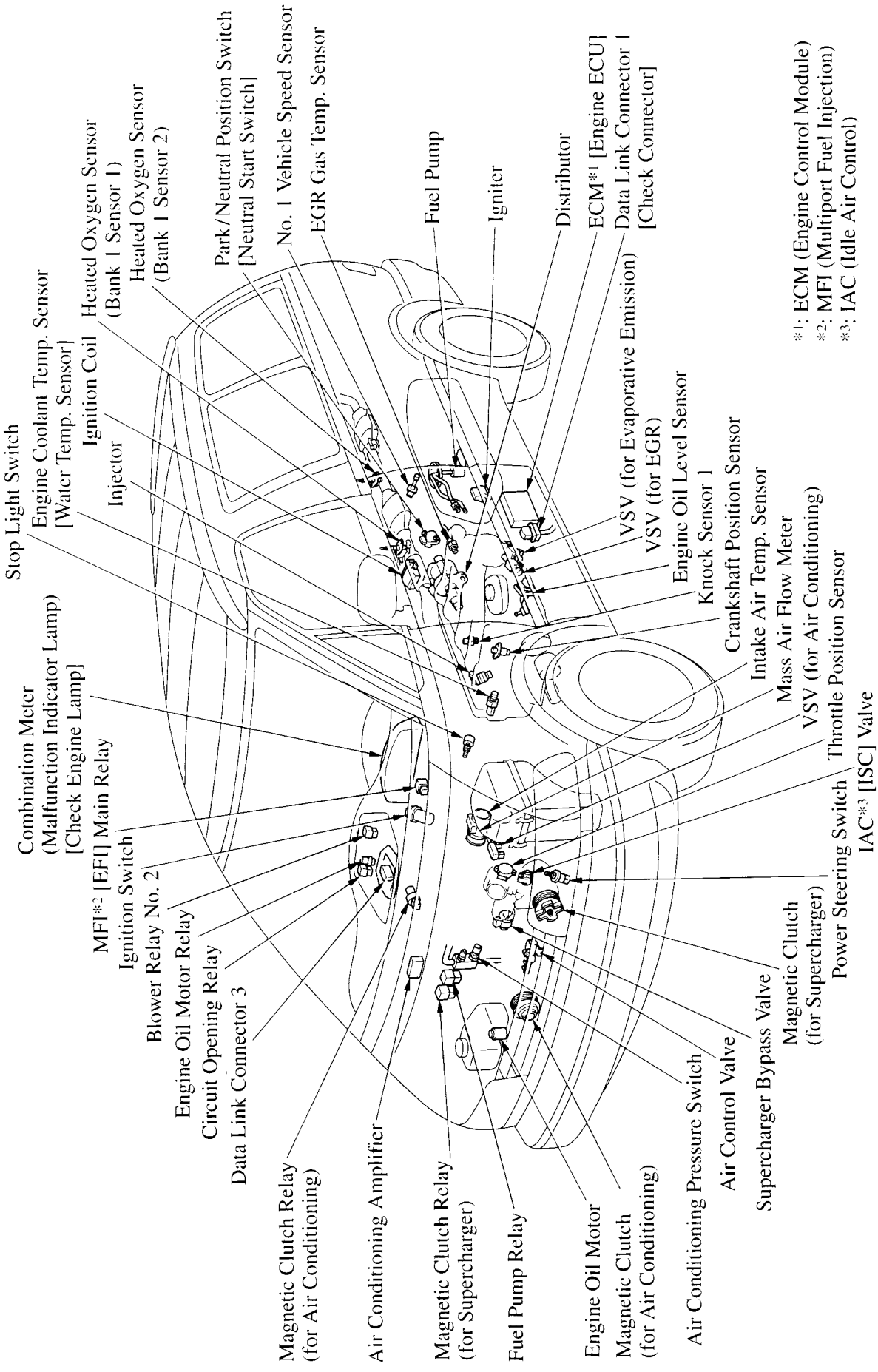


*1: ECM (Engine Control Module)
*2: MFI (Multiport Fuel Injection)
*3: ESA (Electronic Spark Advance)
*4: IAC (Idle Air Control)

3. Engine Control System Diagram



4. Layout of Components



5. Main Components of Engine Control System

General

The following table compares the main components of the 2TZ–FZE engine and 2TZ–FE engine.

Engine Type / Components		2TZ–FZE	2TZ–FE
Mass Air Flow Meter		Hot–Wire Type	—
Volume Air Flow Meter		—	Vane Type
Distributor	Camshaft Position Sensor	1 Pick–Up Coil, 1 Tooth	2 Pick–Up Coils, 1 Tooth
	Crankshaft Position Sensor	—	1 Pick–Up Coil, 24 Teeth
Crankshaft Position Sensor		1 Pick–Up Coil, 34 Teeth	—
Throttle Position Sensor		Linear Type	←
Knock Sensor		Built–In Piezoelectric Type	←
Oxygen Sensor		Heated Oxygen Sensor (Bank 1 Sensor 1)	←
		Heated Oxygen Sensor (Bank 1 Sensor 2)	Oxygen Sensor (Bank 1 Sensor 2)
Injector		Side–Feed Type	←
IAC* [ISC] Valve		Rotary Solenoid Type	←

*: IAC (Idle Air Control)

Mass Air Flow Meter

The hot–wire type mass air flow meter is designed for direct electrical measurement of the intake air mass flow. It has the following features:

- Compact and lightweight
- Ability to measure a wide intake air mass flow
- Superior response and measuring accuracy
- Having no mechanical functions, it offers superior durability.

For details of the principle and operation of the hot–wire type mass air flow meter, see the ’93 1/2 Toyota Supra New Car Features (Pub. No. NCF096U), page 106.

6. MFI (Multiport Fuel Injection) [EFI]

The MFI [EFI] system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine. However, the fuel injection pattern has changed from the simultaneous injection type to the 2–group injection type. For details, see the ’92 Camry New Car Features (Pub. No. NCF077U), page 50.

7. ESA (Electronic Spark Advance)

The ESA system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine. However, torque control compensation during gear shifting has been added.

For details, see the ’90 Celica New Car Features (Pub. No. NCF056U), page 86.

8. IAC (Idle Air Control) [ISC]

The IAC [ISC] system of the 2TZ–FZE engine is basically the same as that of the 2TZ–FE engine.

However, the 2TZ–FZE engine uses an electrical load estimate correction function. The ECM* [engine ECU] performs electrical load estimate correction in accordance with the signals received from the taillight system, rear window defogger system, blower relay No. 2 and stop light switch.

This correction helps prevent sudden drops in idle speed during the initial load of those electrical components.Also, the signals from the air conditioning pressure switch and power steering switch have been included in the relevant signals for the target idle speed control for better engine speed change estimate control.

▶Target Idle Speed◀

Park/Neutral Position Switch [Neutral Start Switch]	Air Conditioning Switch	Air Conditioning Pressure Switch	Power Steering Switch	Engine Speed (rpm)
OFF	OFF	—	OFF	650
			ON	750
	ON	OFF	OFF	650
			ON	750
		ON	OFF	700
			ON	750
ON	OFF	—	ON or OFF	750
	ON	OFF		800
		ON		900

9. Supercharger Control

Magnetic Clutch Control

The supercharger does not operate during low engine load conditions. During acceleration and high engine load conditions, the ECM* [engine ECU] outputs signals which turn on the magnetic clutch relay and engage the magnetic clutch to operate the supercharger.

Supercharger Bypass Valve Control

In accordance with the engine speed, throttle opening angle, and other signals, the ECM* [engine ECU] controls the step motor of the supercharger bypass valve to produce linear torque without fluctuations.

ACV (Air Control Valve) Control

When the engine is started, engine load is low, or engine speed is high, the ECM* [engine ECU] outputs signals to turn on the ACV. The ACV applies atmospheric air pressure to the front and rear bearings of the supercharger to prevent bearing grease and oil from leaking out due to pressure fluctuations.

*: ECM (Engine Control Module)

10. Fuel Pump Control

In accordance with signals received from the ECM* [engine ECU], the fuel pump relay controls the fuel pump to operate at 2 different speeds by switching the fuel pump resistors.

During idle or low engine load conditions, the fuel pump operates at low speed to reduce electric power loss. During high speed or high engine load conditions, the fuel pump operates at high speed to stabilize the fuel supply.

Furthermore, this system operates the fuel pump at high speed during starting to improve restartability by maintaining the proper fuel pressure and preventing fuel vapor lock from occurring.

11. EGR Cut–Off Control

In the 2TZ–FE engine the TVV [BVSV] is used to cut off EGR. In the 2TZ–FZE engine, however, the ECM* [engine ECU] outputs signals to the VSV in accordance with the condition of the engine, and cuts off EGR to maintain the drivability of the vehicle and enhance the durability of the EGR components.

12. Air Conditioning Control

In order for the ECM* [engine ECU] to directly control the magnetic clutch, it also possesses the functions of air conditioning compressor delay control and air conditioning compressor cut–off during acceleration. The basic operation is the same as that of the 2JZ–GE engine. For details, see the ’93 1/2 Toyota Supra New Car Features (Pub. No. NCF096U), page 69.

13. Evaporative Emission Control

The evaporative emission control is a system which controls the duty–cycle VSV to draw the evaporative emissions into the intake air chamber and mix them in with the intake air.
The ECM* [engine ECU] controls the VSV to purge evaporative emissions from the charcoal canister.
For details, see the ’93 1/2 Toyota Supra New Car Features (Pub. No. NCF096U), page 70.

14. Diagnosis

The diagnosis system of the 2TZ–FZE engine complies with OBD–II. For OBD–II requirements, see ’94 Toyota Model New Car Features (Pub. No. NCF099U), page 2. For details of the following items, refer to the ’94 Previa Repair Manual Supplement (Pub. No. RM382U).

Item	Contents
Data Link Connector	Data Link Connector 3 added for OBD–II.
Diagnostic Trouble Code Check Method	Perform by connecting the Toyota hand–held tester to Data Link Connector 3.
Diagnostic Trouble Code	—
ECM* [Engine ECU] Memory Items	Freezed frame data added.

*: ECM (Engine Control Module)

15.Fail–Safe

The fail–safe functions of the 2TZ–FZE engine are as follows:

Circuit with Abnormal Signals	Fail–Safe Function
Mass Air Flow Meter Signal (VG)	Fixed values (standard values) based on the condition of the STA signal and IDL contacts are used for the fuel injection duration and the ignition timing (5° BTDC), making engine operation possible.
Engine Coolant Temp. Sensor [Water Temp. Sensor] Signal (THW)	Fixed value (standard value) is used: 80°C (176°F) for engine coolant temp.
Intake Air Temp. Signal (THA)	Fixed value (standard value) is used: 20°C (68°F) for intake air temp.
Throttle Position Sensor Signal (VTA)	A fixed value of 0° throttle valve opening angle is used.
• Knock Sensor Signal (KNK) • Knock Control System	The corrective retard angle value is set to the maximum value.
Ignition Confirmation Signal (IGF)	Fuel injection is stopped.

■ EMISSION CONTROL SYSTEM

1. System Purpose

System	Abbreviation	Purpose
Positive crankcase ventilation	PCV	Reduces blow–by gas (HC)
Evaporative emission control	EVAP	Reduces evaporative HC
Exhaust gas recirculation	EGR	Reduces NOx
Three–way catalytic converter	TWC	Reduces HC, CO and NOx
Multiport fuel injection [Electronic fuel injection]	MFI [EFI]	Regulates all engine conditions for reduction of exhaust emission

2. Components Layout and Schematic Drawing

For details of the components layout and schematic drawing, refer to the ’94 Previa Repair Manual Supplement (Pub. No. RM382U).