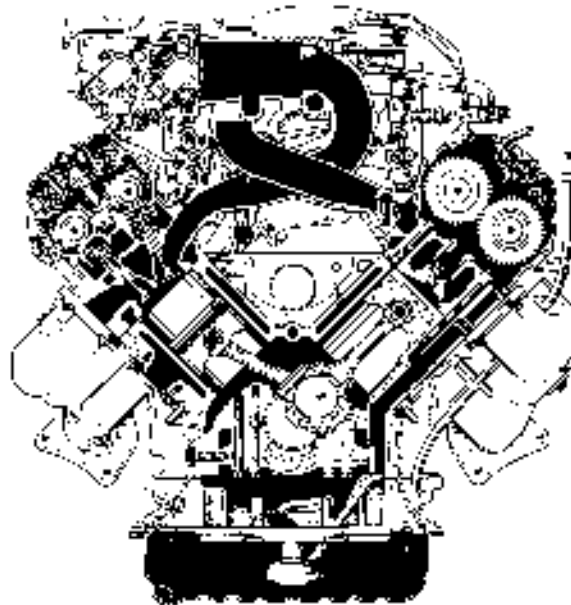
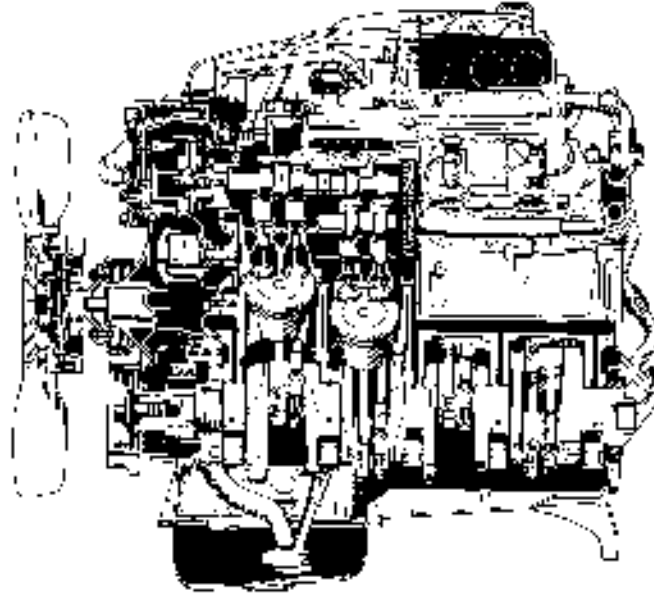


ENGINE

1UZ-FE ENGINE

■ DESCRIPTION

The 1UZ-FE engine in the '94 LS400 is a V8, 4.0-liter, 32-valve DOHC engine. Its construction and operation are basically the same as those of the previous models. However, improvements made to the various areas of the engine result in a lightweight and low-friction engine which provides both high power output and low fuel consumption as well as reduced noise and vibration for an even quieter operation. The diagnosis system of this engine conforms to the OBD-II requirements.

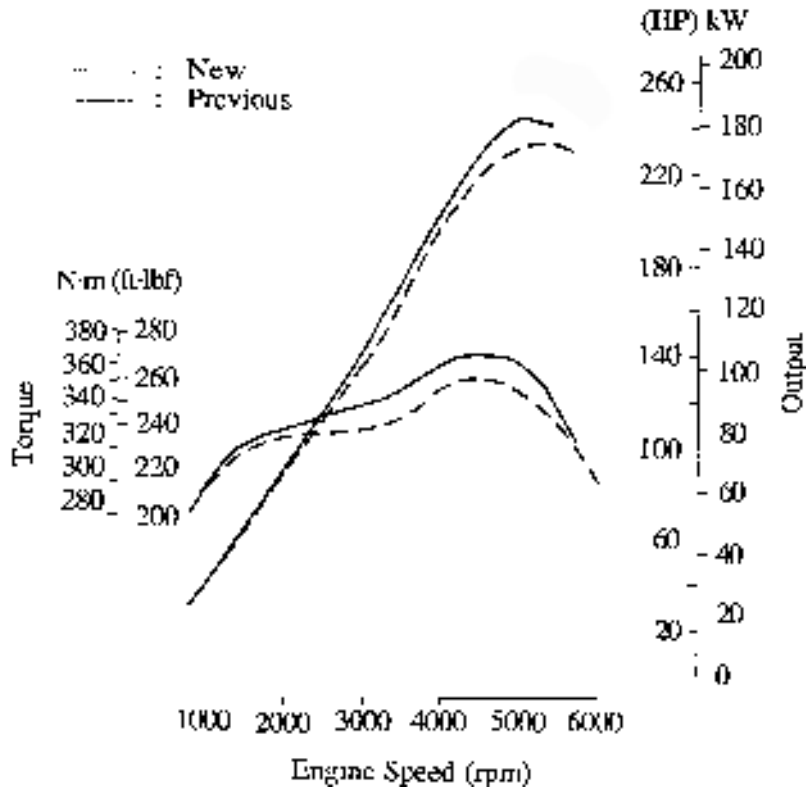


ENGINE SPECIFICATIONS AND PERFORMANCE CURVE

1UZ-FE Engine		New	Previous	
Item				
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* ¹ [EFI]	MFI* ² [EFI]	
Displacement	cm ³ (cu. in.)	3969 (242.1)	←	
Bore x Stroke	mm (in.)	87.5 x 82.5 (3.44 x 3.25)	←	
Compression Ratio		10.4 : 1	10.0 : 1	
Max. Output [SAE-NET]		183 kW @ 5300 rpm (250 HP @ 5300 rpm)	176 kW @ 5600 rpm (240 HP @ 5600 rpm)	
Max. Torque [SAE-NET]		366 N·m @ 4500 rpm (270 ft·lbf @ 4500 rpm)	353 N·m @ 4400 rpm (260 ft·lbf @ 4400 rpm)	
Valve Timing	IN.	Open	6° BTDC	3° BTDC
		Close	46° ABDC	41° ABDC
	EX.	Open	46° BBDC	←
		Close	3° ATDC	←
Fuel Octane Number (RON)		96	←	
Oil Grade		API SH, EC-II, ILSAC* ³ or Better	API SG, SH, EC-II, ILSAC* ³ or Better	

*1: SFI (Sequential Multiport Fuel Injection) *2: MFI (Multiport Fuel Injection)

*3: ILSAC (International Lubricant Standardization and Approval Committee)



■ MAJOR DIFFERENCES

The following changes have been made to the 1UZ-FE engine.

Item	Features
Engine Proper	<ul style="list-style-type: none"> • The water jacket configuration in the cylinder head is modified to improve the cooling performance in the area surrounding the combustion chamber in order to increase the engine's anti-knocking performance. • Passage holes are provided in the crankcase of the cylinder block to reduce pumping loss. • The shape of the piston is modified to produce a lightweight and low-friction piston. At the same time, the piston rings are given less tension to reduce friction loss. • The piston pin, connecting rod, and crankshaft are made lightweight to reduce the noise and vibration.
Valve Mechanism	<ul style="list-style-type: none"> • The valve timing and the amount of valve lift of the intake valve are modified. • The valve spring is given less tension to reduce friction loss. • The crankshaft timing pulley and camshaft timing pulleys are made more lightweight.
Lubrication System	<ul style="list-style-type: none"> • In addition to making the inlet of the oil strainer more compact and lightweight, a lower plate is provided to minimize the amount of air from being drawn in. • An aluminum alloy gasket is used on the oil drain plug of the oil pan.
Cooling System	<ul style="list-style-type: none"> • The number of water pump rotor blades is increased from 7 to 12.
Intake and Exhaust System	<ul style="list-style-type: none"> • The exhaust manifold is changed from the single type to the semi-dual type to improve exhaust efficiency. • The method for joining exhaust pipes together is changed from the flange type to the clamp type.
Engine Mounting	<ul style="list-style-type: none"> • The low-frequency damping coefficient of the liquid-filled compound engine mount is modified to further improve its quietness during idle. • The material of the engine rear mounting bracket is changed to aluminum alloy for weight reduction as well as for reducing the noise and vibration.
Starting System	<ul style="list-style-type: none"> • A compact and lightweight starter with higher torque is used to improve the engine's startability.
Engine Control System	<ul style="list-style-type: none"> • The hot-wire type mass air flow meter improves the accuracy of the intake air volume measurement. • A sequential multiport fuel injection system improves the engine response and reduces exhaust emissions. • The diagnosis system conforms to OBD-II.
Emission Control System	<ul style="list-style-type: none"> • An EGR gas cooler is adopted in the EGR system to improve the engine's anti-knocking performance. • The charcoal canister, a component of the evaporative emission control system, is made larger to improve its HC absorption rate and efficiency.* • A TWC (Three-Way Catalytic Converter) located under the floor has been adopted on all models.

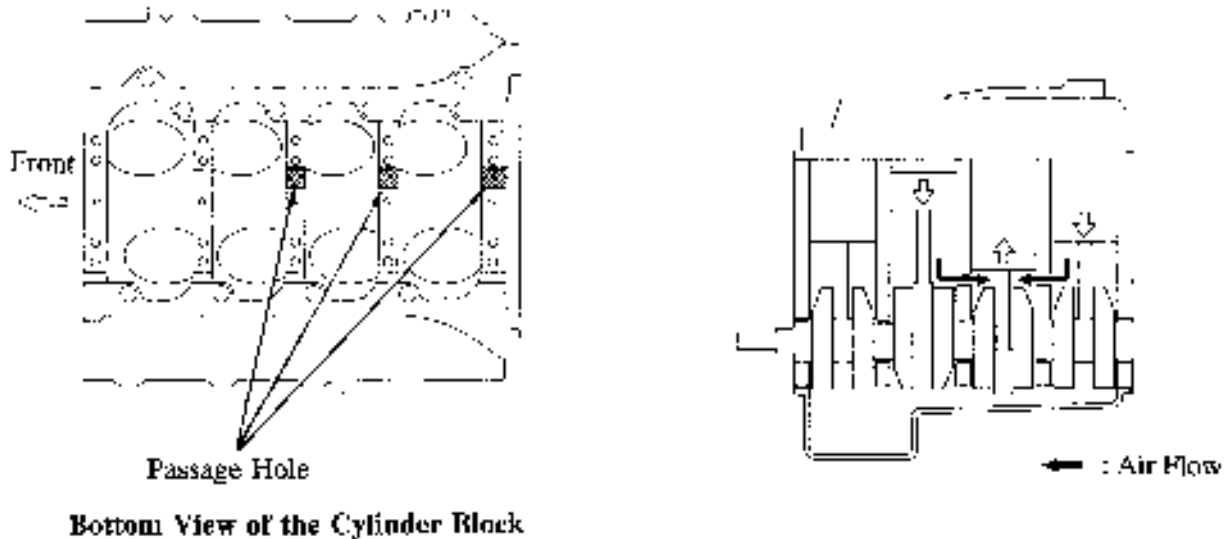
*: California Specification models only.

ENGINE PROPER

1. Cylinder Block

Passage holes [31 mm (1.22 in.) in diameter] are provided in the crankshaft bearing area of the cylinder block. As a result, the air at the bottom of the cylinder flows smoother, and pumping loss (back pressure at the bottom of the piston generated by the piston's reciprocal movement) is reduced to improve the engine's output.

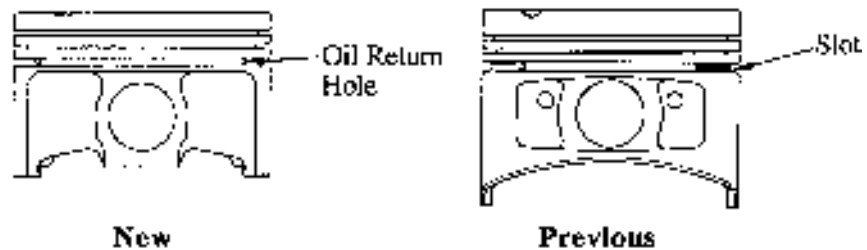
►Air Flow During Engine Revolution◄



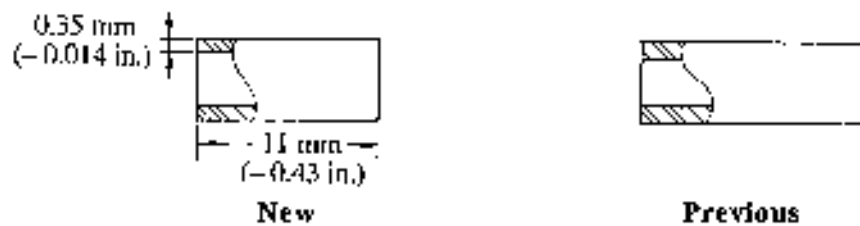
2. Piston

- The piston skirt area is made more compact and lightweight, resulting in reduced friction loss. At the same time, the skirt rigidity is improved to reduce the noise and vibration.
- The steel strut is discontinued for weight reduction.
- The oil return hole in the oil ring groove is changed from the slot type to slotless type.
- The piston rings are given less tension to reduce friction loss.
- The piston pin is made shorter and thinner for weight reduction. As a result, noise and vibration are reduced.

►Piston◄



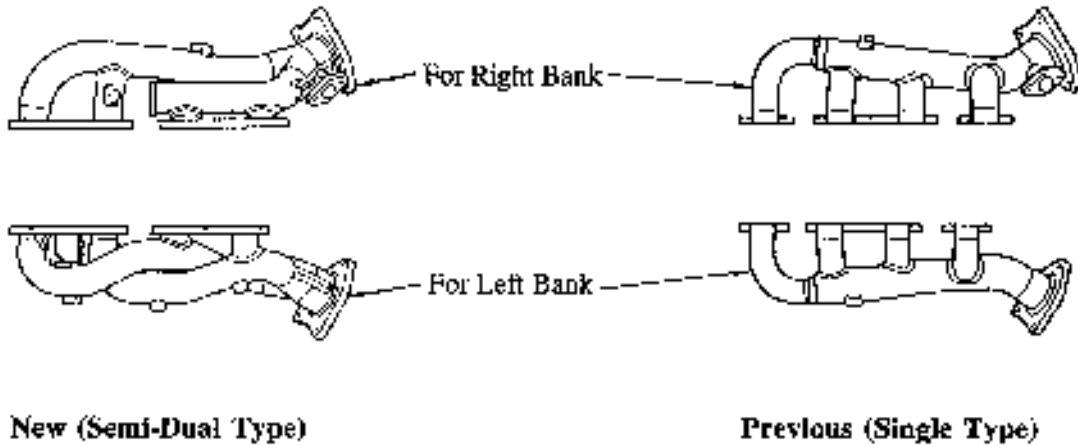
►Piston Pin◄



■ INTAKE AND EXHAUST SYSTEM

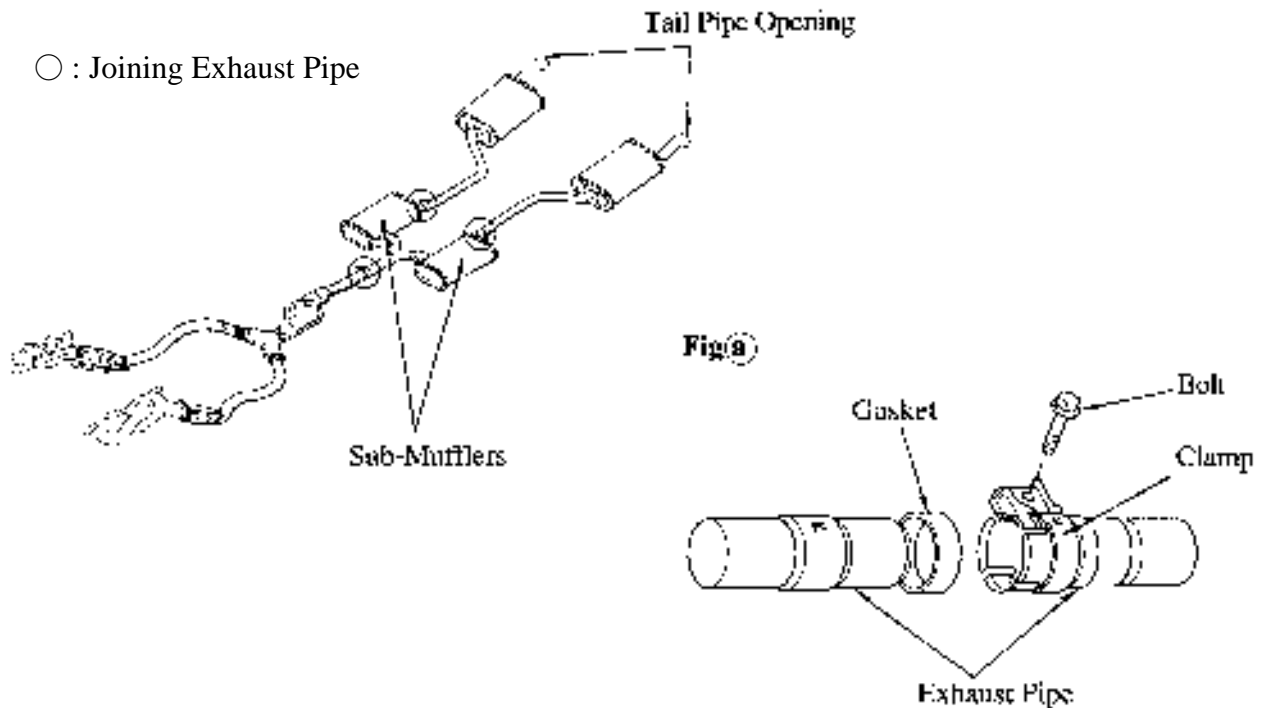
1. Exhaust Manifold

The change from the previous single type to the semi-dual type provides a smoother exhaust gas flow. Accordingly, the engine performance has been improved by reducing exhaust gas interference during low- and mid-range operation, and reducing exhaust back pressure during high-speed operation.



2. Exhaust Pipe

- The capacity of the sub-mufflers is increased (7.5 L x 2 → 8.8 L x 2).
- The method for joining exhaust pipes (Fig. 3) below) is changed from the flange type to the clamp type.
- The tail pipe opening is directed downward to reduce soiling of the bumper by the exhaust gas.



ENGINE CONTROL SYSTEM

1. General

The engine control system of the new 1UZ-FE engine is basically the same in construction and operation as that of the previous 1UZ-FE engine. However, the new 1UZ-FE engine uses a sequential multiport fuel injection system, and a diagnosis system which conforms to OBD-II.

The engine control system of the new 1UZ-FE engine and previous 1UZ-FE engine are compared below.

System	Outline		New	Previous
SFI (Sequential Multiport Fuel Injection) [EFI]	An L-type SFI [EFI] system directly detects the intake air volume with a hot-wire type mass air flow meter.		○	—
	An L-type MFI*1 [EFI] system directly detects the intake air volume with an optical Karman-Vortex type volume air flow meter.		—	○
	The fuel injection system is a sequential multiport fuel injection system.		○	—
	The fuel injection system is a 4-group type and injects to 2 cylinders each.		—	○
	When starting the engine, the fuel injection system sprays fuel into all cylinders at the same time.		—	○
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.		○	○
	The torque control correction during gear shifting has been used to minimize the shift shock.		○	○
	The dwell angle control is implemented by the ECM*2 [engine ECU].		○	—
	2 knock sensors are used to further improve knock detection.		○	○
IAC (Idle Air Control) [ISC]	A step motor type IAC [ISC] system controls the fast idle and idle speeds.		○	○
Fuel Pump Control	Under light engine loads, pump speed is low to reduce electric power loss.	Uses a fuel pump relay and a fuel pump resistor.	○	—
		Uses fuel pump ECU.	—	○
Fuel Pressure Control	In hot engine condition, the fuel pressure is increased to improve restartability.		○	○
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.		○	○

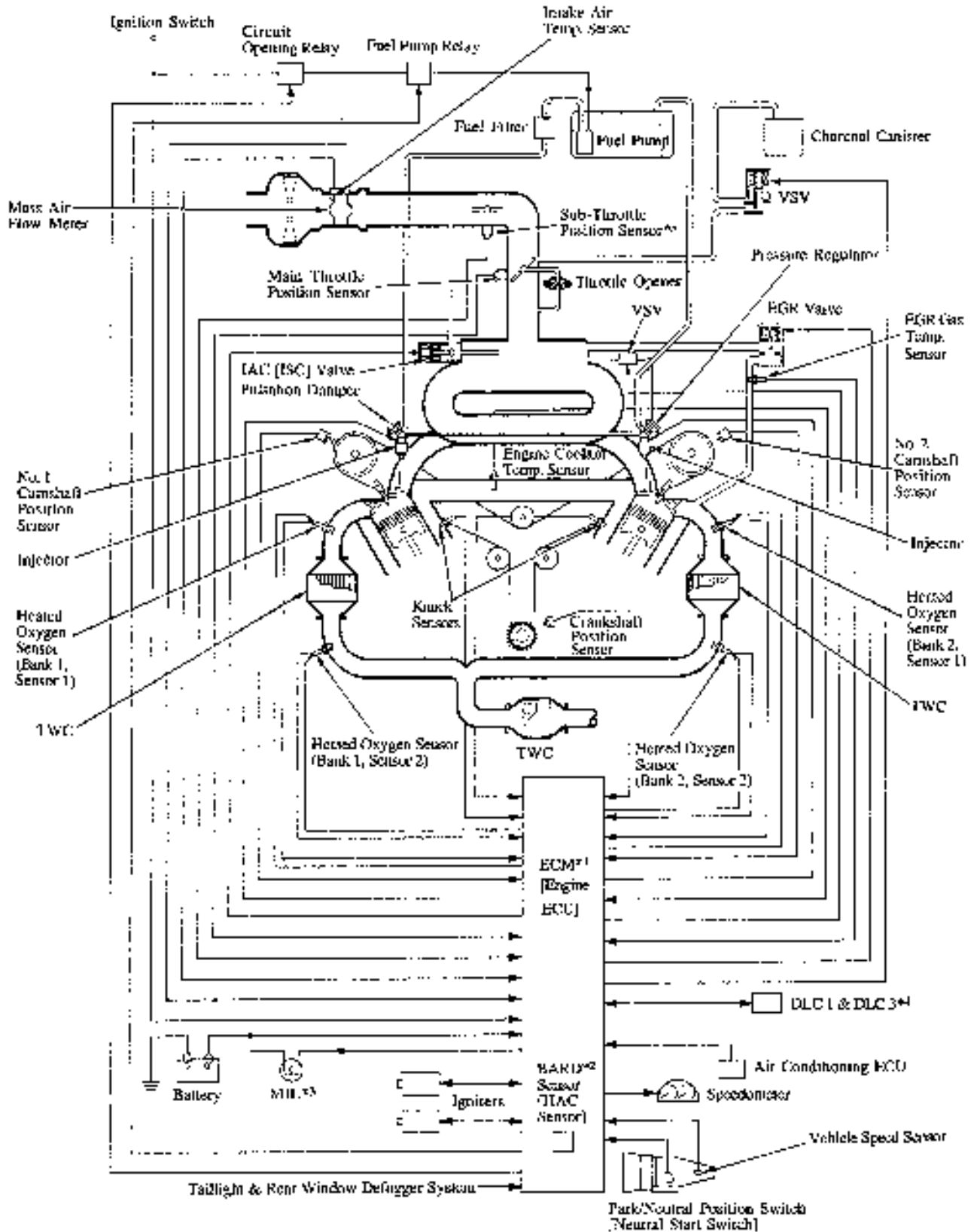
*1: MFI (Multiport Fuel Injection)

*2: ECM (Engine Control Module)

System	Outline	New	Previous
Air Conditioning Cut-Off Control	By controlling the air conditioning compressor ON or OFF in accordance with the engine condition, drivability is maintained.	○	○
EGR Control	Drives the EGR valve with step motor, controlling the EGR volume in accordance with the engine conditions.	○	○
Evaporative Emission Control	The ECM* ² [engine ECU] controls the purge flow of evaporative emissions (HC) in the charcoal canister in accordance with engine conditions.	○	○
Diagnosis	When the ECM* ² [engine ECU] detects a malfunction, the ECM* ² [engine ECU] diagnoses and memorizes the failed section.	○	○
	The diagnosis system complies with OBD-II. The diagnosis items (the failed sections) are discriminated by connecting the Lexus hand-held tester to the newly designed data link connector 3.	○	—
Fail-Safe	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)

3. Engine Control System Diagram



- *1: ECM (Engine Control Module)
- *2: BARD (Barometric Pressure)
- *3: MIL (Malfunction Indicator Lamp) [Check Engine Lamp]
- *4: DLC 1 & 3 (Data Link Connector 1) [Check Connector], (Data Link Connector 3)
- *5: Vehicles equipped with the TRAC (Traction Control) System

5. Main Components of Engine Control System

General

The following table compares the main components of the new 1UZ-FE engine and previous 1UZ-FE engine.

1UZ-FE Engine	New	Previous
Components		
Mass Air Flow Meter	Hot-Wire Type	—
Volume Air Flow Meter	—	Karman-Vortex Type
Crankshaft Position Sensor	Pick-Up Coil Type, 1	←
Camshaft Position Sensor	Pick-Up Coil Type, 2	←
Throttle Position Sensor	Linear Type	←
Knock Sensor	Built-In Piezoelectric Type, 2	←
Oxygen Sensor	Heated Oxygen Sensor (Bank 1, Sensor 1) (Bank 2, Sensor 1) (Bank 1, Sensor 2) (Bank 2, Sensor 2)	Main Heated Oxygen Sensors (LH Bank and RH Bank) Sub-Oxygen Sensors (LH Bank and RH Bank)
Injector	2-Hole Type	←
IAC [ISC] Valve	Step Motor Type	←

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 '94 model Lexus New Car Features (Pub. No. NCF098U), page 33.

6. SFI (Sequential Multiport Fuel Injection) [EFI]

In place of the L-type MFI (Multiport Fuel Injection) [EFI] system with an optical Karman-Vortex type volume air flow meter used in the previous 1UZ-FE engine, the new 1UZ-FE engine uses the L-type SFI [EFI] system with a hot-wire type mass air flow meter. Compared to the previous 1UZ-FE engine, the new 1UZ-FE engine with SFI [EFI] offers the following characteristics:

- Adopts a hot-wire type mass air flow meter with superior measuring precision.
- In place of the 4-group type fuel injection pattern used by the previous 1UZ-FE engine, the new 1UZ-FE adopts a sequential multiport fuel injection type pattern.

Fuel Injection Pattern and Fuel Injection Timing

The new 1UZ-FE engine adopts a sequential multiport fuel injection system in which the air-fuel mixture is introduced into each cylinder every time the engine completes two revolutions. It also optimally regulates the injection timing according to the engine condition.

7. ESA (Electronic Spark Advance)

The ESA system of the new 1UZ-FE engine is basically the same in construction and operation as that of the previous 1UZ-FE engine. However, the dwell angle control which was executed by the igniter is now implemented by the ECM* [engine ECU] in the new model.

8. IAC (Idle Air Control) [ISC]

The IAC system of the new 1UZ-FE engine is basically the same in construction and operation as that of the previous 1UZ-FE engine. However, the new 1UZ-FE engine uses an electrical load estimate correction function. The target idle speed thus varies according to electrical loads such as taillights or rear window defogger.

9. Fuel Pump Control

As in the 1UZ-FE engine of the previous models, this system switches the fuel pump speed between high and low speed according to engine conditions, reducing the electrical load. However, in the new 1UZ-FE engine, the fuel pump speed switching components has been changed from the fuel pump control ECU to fuel pump control relay and resistor. This system is basically the same as that used in the 1UZ-FE engine of the '91 LS400. For details, see '90 LS400 New Car Features (Pub. No. NCF054U) on page 148.

10. Diagnosis

The diagnosis system of the new 1UZ-FE engine complies with OBD-II. For OBD-II requirements, see '94 model Lexus New Car Features (Pub. No. NCF098U), page 2. For details of the following items, refer to the '95 LS400 Repair Manual (Pub. No. RM405U1).

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

*: ECM (Engine Control Module)

11. Fail-Safe

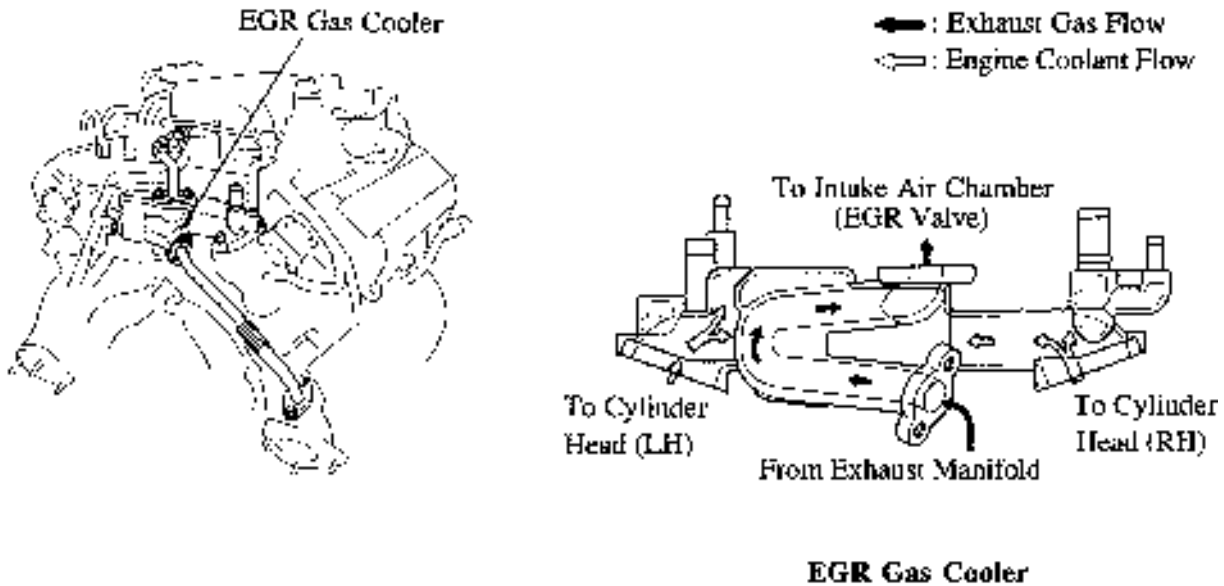
The fail-safe functions of the new 1UZ-FE engine are as follows:

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. Sensor Signal (THA)	Fixed value (standard value) is used: 20°C (68°F) for intake air temp.
Barometric Pressure Sensor [High Altitude Compensation Sensor] Signal (HAC)	Fixed value of 760 mmHg is used.
Main and Sub Throttle Position Sensor Signal (VTA1, 2)	A fixed value of 0° throttle valve opening angle is used.
<ul style="list-style-type: none"> • Knock Sensor Signal (KNK1, 2) • Knock Control System 	The corrective retard angle value is set to the maximum value.
Ignition Confirmation Signal (IGF1, 2)	Fuel injection is stopped.

■ EMISSION CONTROL SYSTEM

1. EGR (Exhaust Gas Recirculation) System

In addition to the EGR system components used in the previous model, an EGR gas cooler is adopted. It is enclosed in the rear water bypass joint in the back of the engine and uses the engine coolant to cool the exhaust gases which are later drawn into the intake air chamber. This system suppresses the intake air temperature from rising due to the exhaust gases and thus improves the engine's anti-knocking performance.



2. Evaporative Emission Control System

Charcoal Canister

The construction of the charcoal canister for the California specification models is changed and its capacity is increased (1.4 L → 2.0 L) to improve the canister's HC absorption performance and efficiency. The construction of the charcoal canister is basically the same as the '94 ES300; see the '94 model Lexus New Car Features (Pub. No. NCF110U), page 8.