■1GR-FE ENGINE

1. General

- Except for Mexico package models, in order to comply with the LEVII-ULEV emission regulation, the characteristics of the Three-Way catalytic Converters (TWC), which are fitted on the exhaust manifold and exhaust pipes, have been optimized and also an air injection system has been provided.
- Since the air injection system has been provided, the exhaust manifold shape has been redesigned.

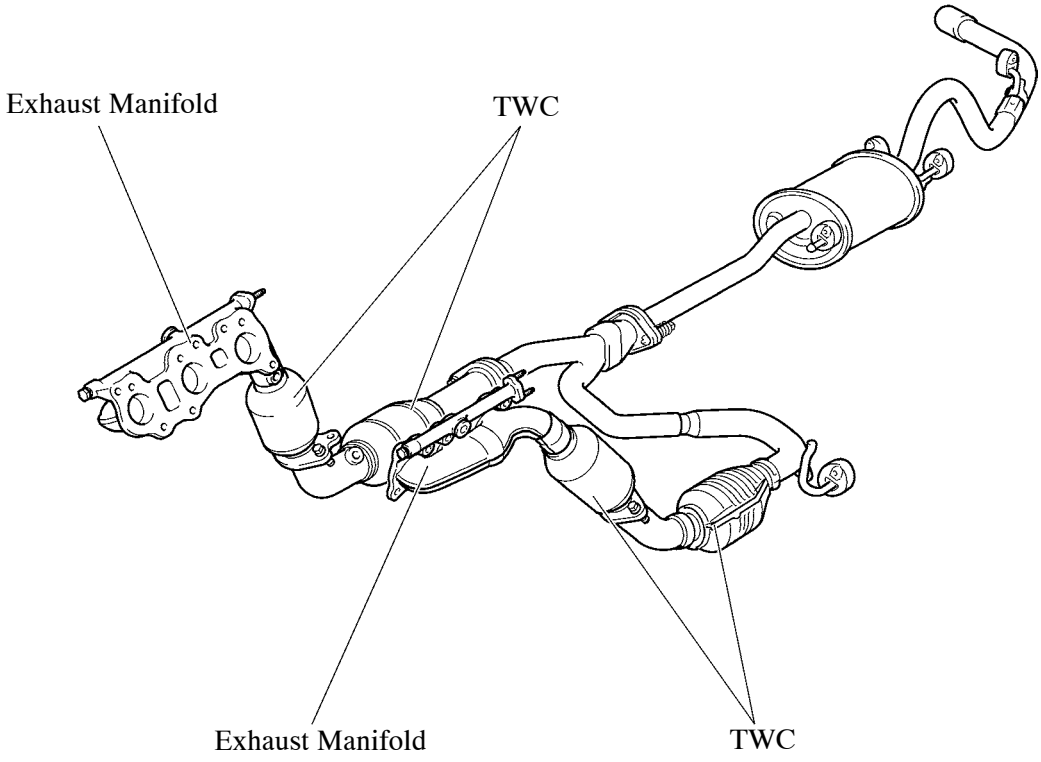
▶ Engine Specifications ◀

Models			’12 TACOMA	’11 TACOMA
No. of Cyls. & Arrangement			6-Cylinder, V Type	←
Valve Mechanism			24-Valve DOHC, Chain Drive (with VVT-i)	←
Combustion Chamber			Pentroof Type	←
Manifolds			Cross-Flow	←
Fuel System			SFI	←
Displacement cm^3 (cu. in.)			3956 (241.4)	←
Bore × Stroke mm (in.)			94.0 × 95.0 (3.70 × 3.74)	←
Compression Ratio			10.0 : 1	←
Max. Output (SAE-NET)			176 kW @ 5200 rpm (236 HP @ 5200 rpm)	←
Max. Torque (SAE-NET)			361 N·m @ 4000 rpm (266 ft·lbf @ 4000 rpm)	←
Valve Timing	Intake	Open (BTDC)	–8° to 42°	←
		Close (ABDC)	60° to 10°	←
	Exhaust	Open (BBDC)	54°	←
		Close (ATDC)	2°	←
Firing Order			1 – 2 – 3 – 4 – 5 – 6	←
Oil Grade			ILSAC	←
Octane Rating (Research Octane Number)			87 or higher (91 RON or higher)	←
Emission Regulation	Tailpipe	CARB*1	LEVII-ULEV, SFTP/ LEVII-LEV, SFTP*3	LEVII-LEV, SFTP
		EPA*2	Tier2-Bin5, SFTP	←
	Evaporative		LEVII, ORVR	←
Engine Service Mass*4 kg (lb)		M/T	196 (432.1)	←
		A/T	183 (403.4)	←

*1: California Air Resources Board
*2: Environmental Protection Agency
*3: Mexico package models
*4: The figure shown is the weight of the part without coolant and oil.

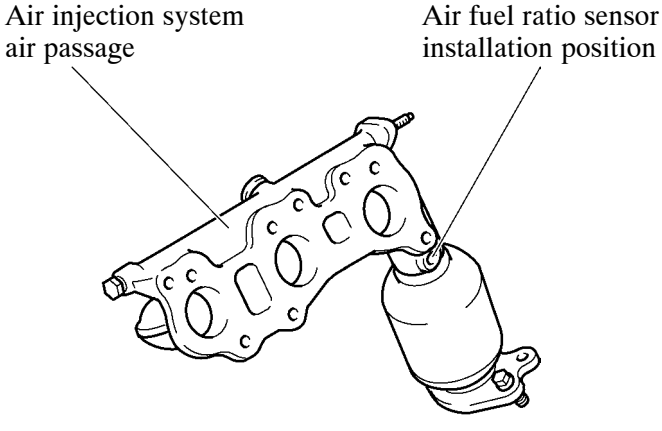
2. Intake and Exhaust System

- In order to enhance the efficiency of the Three-Way catalytic Converters (TWC) fitted on the exhaust manifold and exhaust pipes, the catalyst volume, amount of precious metal, cell density and wall thickness have been optimized.
- An air passage of the air injection system has been fitted on the flange of the exhaust manifold, and the air fuel ratio sensor has been relocated.



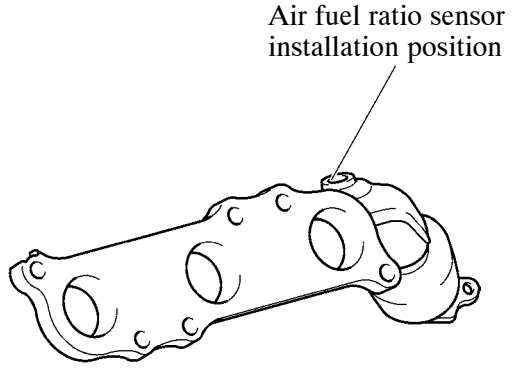
18RNF29Y

▶ Exhaust Manifold ◀



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Models with Air Injection System



18RNF31Y

Models without Air Injection System

3. Engine Control System

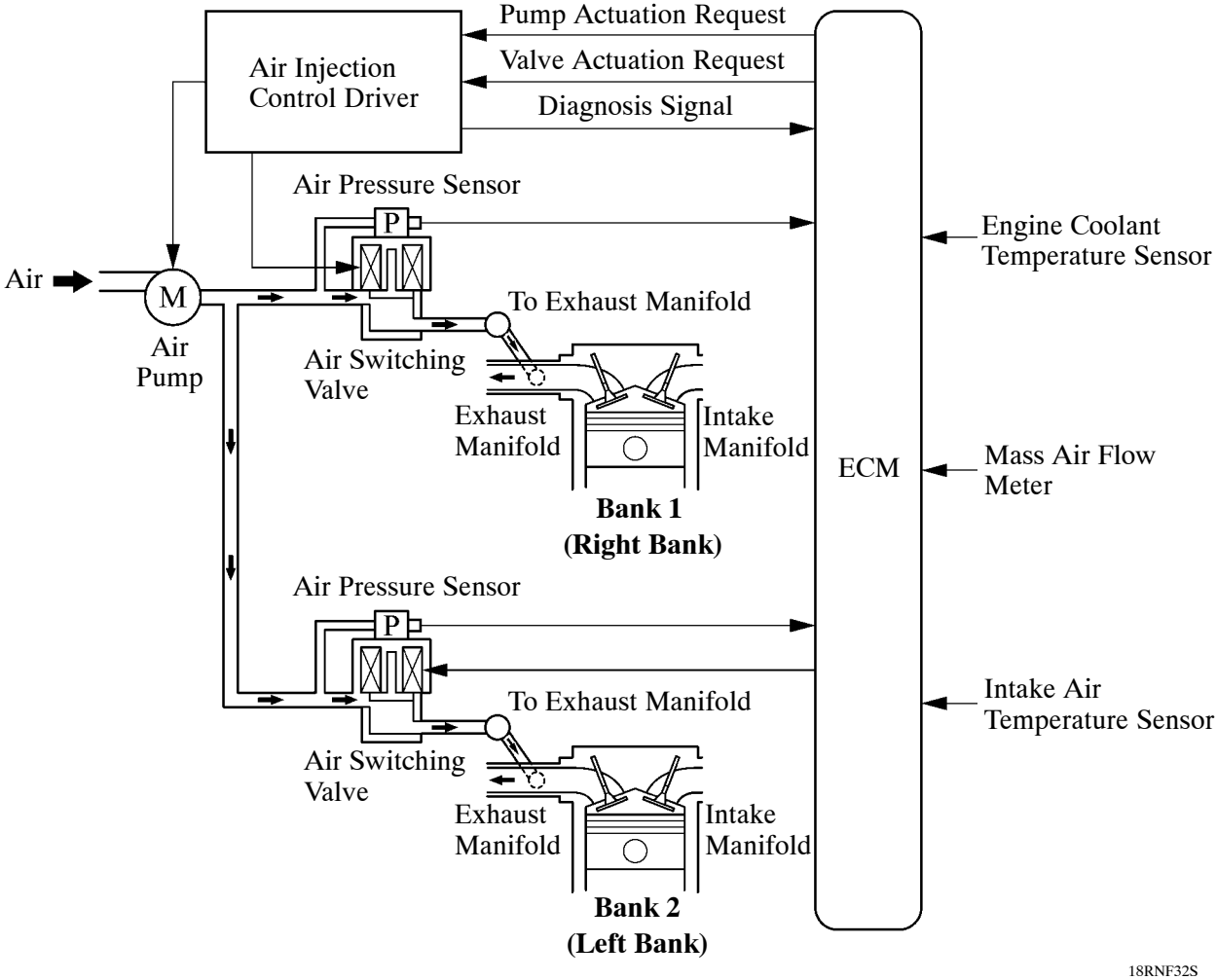
Air Injection System

- To ensure the proper warm-up performance of the Three-Way catalytic Converter (TWC) after starting a cold engine, an air injection system is used.
- This system consists of an electric air pump, air injection control valve, air pressure sensor and air injection control driver.
- The ECM estimates the amount of air injected to the TWC based on signals from the mass air flow meter in order to regulate the air injection time.
- Air is injected under the following conditions.

▶ Operation Conditions ◀

Engine Coolant Temp.	5 to 45°C (41 to 113°F)
Intake Air Temp.	5°C (41°F) or more

▶ System Diagram ◀

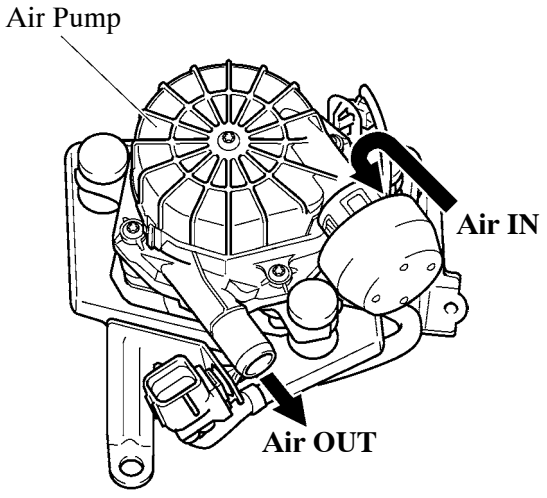


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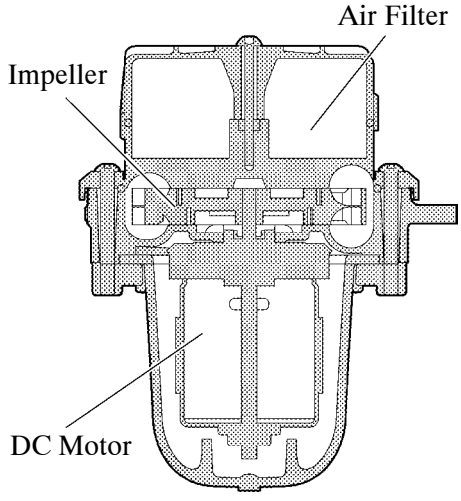
1) Construction and Operation

a. Air Pump

- An air pump consists of a DC motor, an impeller and an air filter.
- The DC motor is controlled by the air injection driver in accordance with signals from the ECM. The motor supplies air into an air injection control valve through the impeller.
- The air filter is maintenance-free.



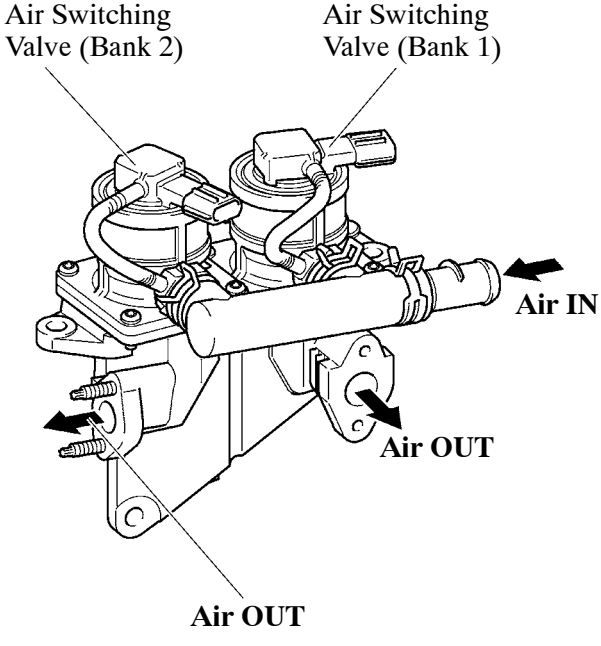
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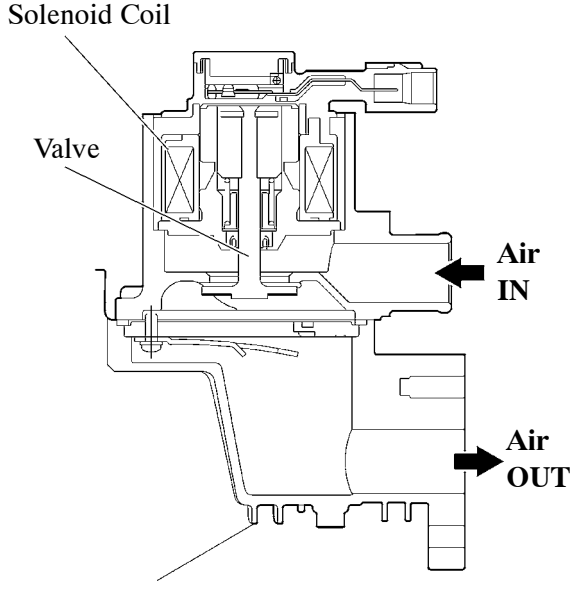
Cross Section 18RNF34S

b. Air Switching Valve

- The air switching valve 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 the operation timing of the air pump.
- Each air pressure sensor is built into the corresponding air switching valve.
- The structure and function of the air switching valve for the bank 1and bank 2 are basically the same.



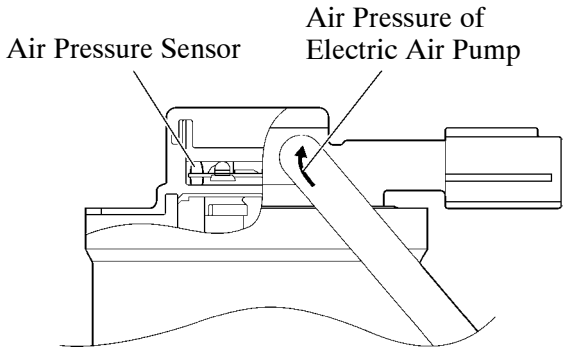
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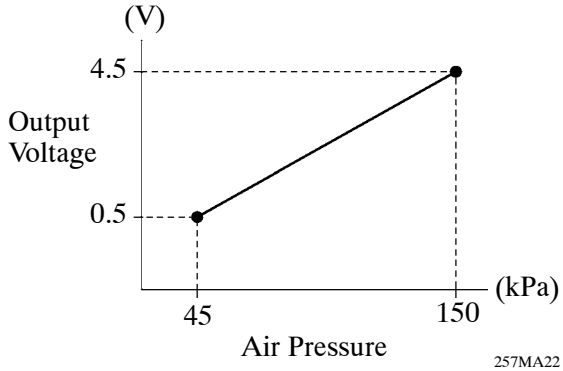
Cross Section 18RNF36S

c. Air Pressure Sensor

- The air pressure sensor consists of a semiconductor, which has a 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.
- The structure and function of the air pressure sensor for the bank 1 and bank 2 are basically the same.



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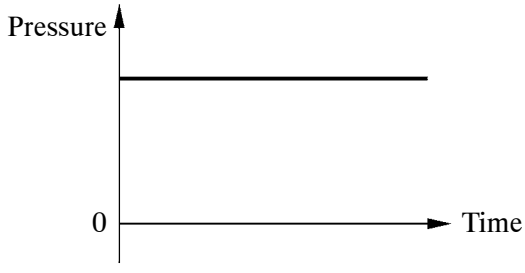


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- The ECM detects operation of the air injection system based on signals from the air pressure sensor as follows:

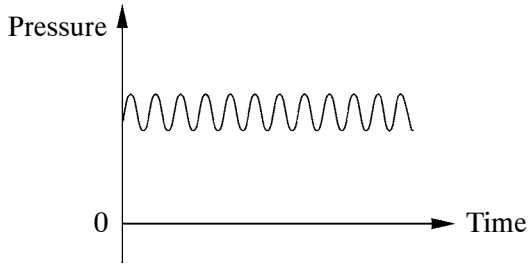
1) When the air pump is ON and the air switching valve is closed, the pressure is stable.
2) When the air pump is ON and the air switching valve is open, the pressure drops slightly and becomes unstable because of exhaust pulses.
3) When the air pump is OFF and the air switching valve is closed, the pressure remains at zero.
4) When the air pump is OFF and air switching valve is open, the pressure drops below zero and becomes unstable because of exhaust pulses.

Example: 1



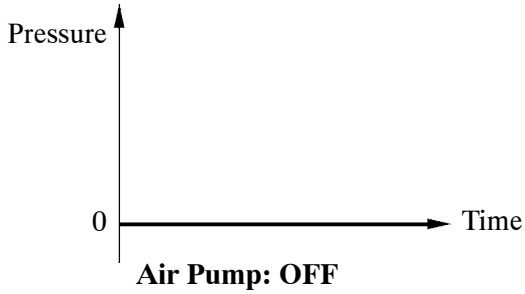
Air Pump: ON
Air Switching Valve: Closed

Example: 2



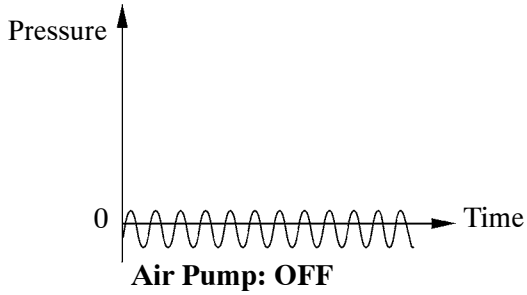
Air Pump: ON
Air Switching Valve: Open

Example: 3



Air Pump: OFF
Air Switching Valve: Closed

Example: 4

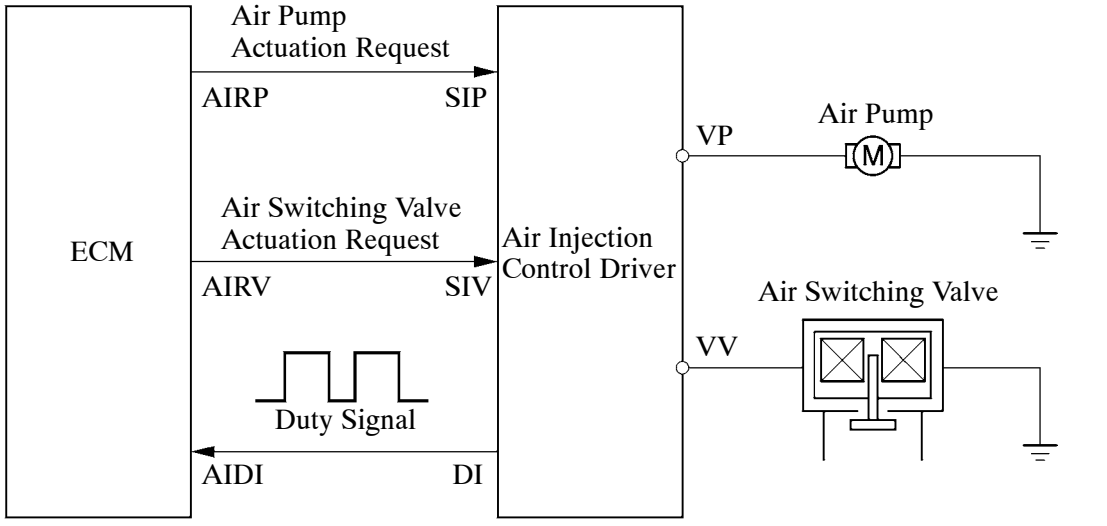


Air Pump: OFF
Air Switching Valve: Open

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d. Air Injection Control Driver

- A semiconductor type air injection control driver is used. Activated by the ECM, this driver actuates the air pump and the air switching valve.
- The air injection control driver also detects failures in the input and output circuits of 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 air pump actuation circuit).	—	—	200 ms 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	