

2UZ-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2440-P2443: Secondary Air Injection System Switching Valve Stuck Open Bank1 (2008 Tundra)

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Model Year: 2008	Model: Tundra	Doc ID: RM0000013HC00EX
Engine Family: 1GR-FE, A750E 2UZ-FE, A750E 2UZ-FE, A750F 3UR-FE, AB60E 3UR-FE, AB60F	Body Type: Double Cab	VDS: BT541 BT581 BV541 BV581 CT541 CV541 DT541 DT581 DV541 DV581 ET541 ET581 EV541 EV581 JT521 JU521 JV521 KT521 KV521 LT521 LU521 LV521 MT521 MV521 RT541 RT581 RU541 RV541 RV581 ST541 SV541
Title: 2UZ-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P2440-P2443: Secondary Air Injection System Switching Valve Stuck Open Bank1 (2008 Tundra)		

DESCRIPTION

DTC	P2440	Secondary Air Injection System Switching Valve Stuck Open Bank1
DTC	P2441	Secondary Air Injection System Switching Valve Stuck Close Bank1
DTC	P2442	Secondary Air Injection System Switching Valve Stuck Open Bank 2
DTC	P2443	Secondary Air Injection System Switching Valve Stuck Closed Bank 2

DESCRIPTION

Refer to DTC P0412 [Click here for more information.](#)

DTC Code	DTC Detection Condition	Trouble Area
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DTC Code	DTC Detection Condition	Trouble Area
P2440 P2442	Pressure sensor detects pulsation of exhaust gas despite ECM commanding Air Switching Valve (ASV) to close, while engine running (1 trip detection logic)	<ul style="list-style-type: none"> ASV Open or short in ASV circuit Pressure sensor Pressure sensor circuit Air Injection Control Driver (AID) ECM
P2441 P2443	Pressure sensor detects no pulsation of exhaust gas despite ECM commanding Air Switching Valve (ASV) to open, while engine running (2 trip detection logic)	<ul style="list-style-type: none"> ASV Open or short in ASV circuit Vacuum hose (ASV - pressure sensor) Air injection hose Pressure sensor Pressure sensor circuit Air Injection Control Driver (AID) ECM

HINT:

Air switching valve normal operation:

When the Air Switching Valve (ASV) is open, exhaust gas pulsation occurs in the secondary air passage.

When the ASV is closed, exhaust gas pulsation does not occur in the secondary air passage.

MONITOR DESCRIPTION

The ECM monitors the pressure in the secondary air passage using the pressure sensor connected to the ASV of the Secondary Air Injection (AIR) system.

If either of the following conditions occurs, the ECM interprets it as a malfunction of the AIR system, and illuminates the MIL and sets a DTC:

- Exhaust gas pulsation is detected by the pressure sensor despite the ECM commanding the ASV to close.
- Exhaust gas pulsation is not detected by the pressure sensor despite the ECM commanding the ASV to open.

MONITOR STRATEGY

Related DTCs	P2440: Air control valve stuck open P2441: Air control valve stuck closed P2442: Air control valve stuck open P2443: Air control valve stuck closed
Required Sensors/Components (Main)	Pressure sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per drive cycle
Duration	2 seconds: Case 3 7 seconds: Case 1, 2
MIL Operation	1 driving cycle: Case 3 2 driving cycles: Case 1, 2
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS**All:**

Monitor runs whenever following DTCs not present	P0010 - P0022: VVT System
	P0031 - P0052: Front A/F Sensor Heater
	P0102 - P0103: MAF sensor
	P0110 - P0113: IAT sensor
	P0115 - P0118: ECT sensor
	P0120 - P2125: TP sensor
	P0125: Insufficient ECT for Closed Loop
	P0171 - P0175: Fuel trim
	P0300 - P0308: Misfire
	P0325 - P0333: Knock sensor
	P0335: CKP sensor
	P0340 - P0346: VVT sensor
	P0351 - P0358: Igniter
	P0441 - P2420: EVAP system
	P0500: VSS
	P1340: CMP sensor
	P2195 - P2A03: A/F sensor
	P2430 - P2433: AIR Pressure Sensor (Low/High)
Battery voltage	11 V or higher
Atmospheric pressure	45 kPa (337.5 mmHg) or more

Case 1:

Time after secondary injection operation begins	5 seconds or more
Secondary air injection pump	ON
Secondary air injection switching valve	ON
Delay time after engine started	5 seconds or more
Pressure sensor malfunction	Not detected

Case 2:

Secondary air injection pump	OFF
Secondary air injection system monitor during secondary air injection ON	Completed
Pressure sensor malfunction	Not detected

Case 3:

Cumulative intake air amount	150 g/sec. or more
AIR pump	OFF
AIR valve	OFF
AIR status	OFF
Pressure sensor malfunction	Not detected

TYPICAL MALFUNCTION THRESHOLDS**Condition 1:**

AIR pressure during AIR ON	1 kPa or more and pulse is generated
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Condition 2:

AIR pressure during AIR ON	Less than 1 kPa and pulse is generated
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Condition 3:

AIR pressure during AIR ON	1 kPa or more and pulse is not generated
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Condition 4:

AIR pressure during AIR ON	Less than 1 kPa and pulse is not generated
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Condition 5:

AIR pressure during AIR OFF	5 kPa or more and pulse is generated
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Condition 6:

AIR pressure during AIR OFF	Less than 5 kPa and pulse is generated
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Condition 7:

AIR pressure during AIR OFF	5 kPa or more and pulse is not generated
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Condition 8:

AIR pressure during AIR OFF	Less than 5 kPa and pulse is not generated
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Case 1:

Any of following conditions met:	(a), (b) or (c)
(a) Conditions 1 and 6	Met
(b) Conditions 1 and 5	Met

(c) Conditions 2 and 6	Met
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Case 2:

Any of following conditions met:	(a), (b) or (c)
(a) Conditions 3 and 7	Met
(b) Conditions 3 and 8	Met
(c) Conditions 4 and 8	Met

Case 3:

Cumulative pressure pulsation	100 kPa or more
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MONITOR RESULT

Refer to Checking Monitor Status [Click here for more information.](#)

WIRING DIAGRAM

Refer to DTC P0412 [Click here for more information.](#)

INSPECTION PROCEDURE**HINT:**

Determination by ECM monitoring:

The ECM locates malfunctions in the Secondary Air Injection (AIR) system by detecting the pressure in the AIR passage between the air pump and Air Switching Valve (ASV) and sets a DTC. Soon after cold engine starts, the monitor runs for a short time while the AIR system is both ON and OFF. The ECM detects both the pressure and the exhaust pulsation and compares them.

The following 8 patterns are AIR system pressure conditions in the AIR system passage.

Pressure Condition in Secondary Air Injection System Case 1:

Air Pump	ON
Air Switching Valve	Open
Pressure	1 kPa or more
Pulsation Detection	Exhaust gas pulsation detected

Pressure Condition in Secondary Air Injection System Case 2:

Air Pump	OFF
Air Switching Valve	Open
Pressure	Less than 1 kPa
Pulsation Detection	Exhaust gas pulsation detected

Pressure Condition in Secondary Air Injection System Case 3:

Air Pump	ON
Air Switching Valve	Closed
Pressure	1 kPa or more
Pulsation Detection	Exhaust gas pulsation not detected

Pressure Condition in Secondary Air Injection System Case 4:

Air Pump	OFF
Air Switching Valve	Close
Pressure	Less than 1 kPa
Pulsation Detection	Exhaust gas pulsation not detected

Pressure Condition in Secondary Air Injection System Case 5:

Air Pump	ON
Air Switching Valve	Open
Pressure	5 kPa or more
Pulsation Detection	Exhaust gas pulsation detected

Pressure Condition in Secondary Air Injection System Case 6:

Air Pump	OFF
Air Switching Valve	Open
Pressure	Less than 5 kPa
Pulsation Detection	Exhaust gas pulsation detected

Pressure Condition in Secondary Air Injection System Case 7:

Air Pump	ON
Air Switching Valve	Closed
Pressure	5 kPa or more
Pulsation Detection	Exhaust gas pulsation not detected

Pressure Condition in Secondary Air Injection System Case 8:

Air Pump	OFF
Air Switching Valve	Close
Pressure	Less than 5 kPa
Pulsation Detection	Exhaust gas pulsation not detected

If the detected pressure is high, the air pump is assumed to be ON and if it alternates sharply, the ASV is assumed to be open. The ECM locates malfunctions from the combination of pressures detected when the AIR system is ON and OFF.

HINT:

The exhaust pulsation value is calculated in the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

HINT:

- In case 3 and 7, as the pressure sensor detects a slight pump operation pulsation, the detected value is not constant. Since the pump outlet is blocked by closing the ASV, the average pressure is higher than in case 1 (approximately 20 to 30 kPa).
- In case 1, the average pressure is approximately 3 to 11 kPa. The value of 1 kPa indicated in the table above is a threshold for detecting pump malfunctions.

Detected Conditions while AIR operating:	Detected Conditions while AIR not operating:	ECM Determination	DTCs Output
Air pump ON, ASV Open	Air pump OFF, ASV Closed		
Case 1	Case 8	Normal	-
Case 1	Case 6	ASV stuck open	P2440 or P2442
Case 1	Case 7	Air pump stuck ON	P2444 or P2446
Case 2	Case 8	Air pump stuck OFF	P2445 or P2447
Case 3	Case 8	ASV stuck closed	P2441 or P2443

Detected Conditions while AIR operating: Air pump ON, ASV Open	Detected Conditions while AIR not operating: Air pump OFF, ASV Closed	ECM Determination	DTCs Output
Case 1	Case 5	ASV stuck open and air pump stuck ON	P2440 and P2444 or P2442 and P2446
Case 2	Case 6	ASV stuck open and air pump stuck OFF	P2440 and P2445 or P2442 and P2447
Case 3	Case 7	ASV stuck closed and air pump stuck ON	P2441 and P2444 or P2443 and P2446
Case 4	Case 8	ASV stuck closed and air pump stuck OFF	P2441 and P2445 or P2443 and P2447

HINT:

- If the vacuum hose between the ASV and the pressure sensor is not connected correctly, case 4 may occur.
- By using the Techstream to perform the Air Injection Check operation in the System Check, the air-fuel ratio and the pressure in the secondary air injection system passage can be checked while the secondary air injection system is operating. This helps technicians to troubleshoot the system when it malfunctions. Furthermore, Pending Codes also can be checked by performing Utility / Air Injection Check / Automatic Mode after the repair.
- Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

System Check:

The pressure in the secondary air passage can be checked using the Techstream.

- a. Start the engine and warm it up.
 - b. Turn the ignition switch off.
 - c. Connect the Techstream to the DLC3.
 - d. Turn the ignition switch to ON and turn the Techstream ON.
 - e. Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / AIR PUMP 1: ON, ASV1: OPEN, AIR PUMP 2: ON, ASV2: OPEN and AIR PUMP 1: OFF, ASV1 CLOSE, AIR PUMP 2: OFF, ASV2 CLOSE.
- HINT:

When Manual Mode is selected, the Techstream initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AIR PUMP and ASV operation can be selected.

- f. Start the engine.
 - g. Perform the AIR system intrusive operation while the engine is idling.
 - h. Check that the air pump (AIR PUMP), ASV and pressure in the AIR system passage (PRESSURE) displayed on the Techstream indicate the conditions shown in the table below.
- Standard:

Tester Operations	AIR PUMP	ASV	PRESSURE*1	PULSATION*2
AIR PUMP: ON, ASV: OPEN	ON	OPEN	1 kPa or more	15 kPa or more
AIR PUMP: OFF, ASV: CLOSE	OFF	CLOSE	Less than 5 kPa	Less than 30 kPa

*1:

Average pumping pressure (gauge pressure). The pressure should be 1 kPa or more when the AIR system operates.

*2:

The cumulative exhaust pulsation calculated by the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

- i. Turn the ignition switch off.

NOTICE:

- o This Air Injection Check only allows technicians to operate the AIR system for a maximum of 5 seconds.
Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.

While AIR system operation using the Techstream is prohibited, the Techstream display indicates the prohibition (WAIT or ERROR).

If an ERROR is displayed on the Techstream during the test, stop the engine for 10 minutes, and then try again.

- Performing the Air Injection Check repeatedly may cause damage to the AIR system. If necessary, leave an interval of several minutes between System Check operations to prevent the system from overheating.
- When performing the Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.
- Turn the ignition switch off when the Air Injection Check operation finishes.

PROCEDURE

1.	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO SECONDARY AIR INJECTION SYSTEM DTCS)
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- (a) Connect the Techstream to the DLC3.
- (b) Turn the ignition switch to ON and turn the Techstream ON.
- (c) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- (d) Read DTCs.

Result

Result	Proceed to
P2440, P2441, P2442 and/or P2443 are output	A
P2440, P2441, P2442 and/or P2443 and P0412 and/or P0415 are output	B
P2440, P2441, P2442 and/or P2443 and other DTCs (except P0412 and P0415) are output	C

If any DTCs other than P0412, P0415, P2440, P2441, P2442 and/or P2443 are output, troubleshoot those DTCs first.

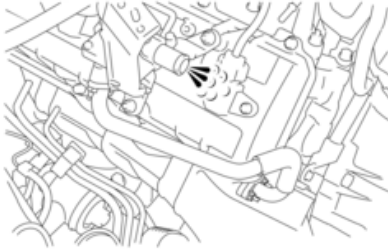
C	▶ GO TO DTC CHART
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B	▶ GO TO AIR SWITCHING VALVE INSPECTION PROCEDURE (P0412 AND P0415)
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A
▼

2.	PERFORM ACTIVE TEST USING TECHSTREAM
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for Bank 1:



for Bank 2:



(a) Visual check

(1) Start the engine and warm it up.

(2) Turn the ignition switch off.

(3) Disconnect the No. 2 air injection system hose and No. 2 air hose.

(4) Connect the Techstream to the DLC3.

(5) Turn the ignition switch to ON and turn the Techstream ON.

(6) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / AIR PUMP 1: ON, ASV1: OPEN, AIR PUMP 2: ON, ASV2: OPEN.

HINT:

When Manual Mode is selected, the Techstream initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.

(7) Start the engine.

(8) Perform the AIR system intrusive operation while the engine is idling.

(9) Place your hand near the air switching valve port and check that the exhaust gas pressure pulsates when the ASV is turned ON.

CAUTION:

To avoid the danger of being burned by the exhaust gas, bring your hand close to the valve port slowly.

(10) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / AIR PUMP 1: ON, ASV1: OPEN, AIR PUMP 2: ON, ASV2: OPEN and AIR PUMP 1: ON, ASV1: CLOSE, AIR PUMP 2: ON, ASV2: CLOSE.

(11) Check that the exhaust gas does not pulsate when the ASV is turned OFF.

(12) Turn the ignition switch off.

NOTICE:

- This Air Injection Check only allows technicians to operate the AIR system for a maximum of 5 seconds. Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks. While AIR system operation using the Techstream is prohibited, the Techstream display indicates the prohibition (WAIT or ERROR).

If an ERROR is displayed on the Techstream during the test, stop the engine for 10 minutes, and then try again.

- Performing the Air Injection Check repeatedly may cause damage to the AIR system. If necessary, leave an interval of several minutes between System Check operations to prevent the system from overheating.
- When performing the Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.
- Turn the ignition switch off when the Air Injection Check operation finishes.

Standard:

Air Pump Operations	ASV Operations	Exhaust Gas Pulsation
ON	OFF	Not detected
ON	ON	Detected

(b) Other inspection method:

(b) The ASV operation can be confirmed by checking the cumulative pressure pulsation* provided in the System Check.

(b) Perform System Check operation under Manual Mode.

(b) *: The exhaust pulsation value is calculated in the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

(1) Start the engine and warm it up.

(2) Turn the ignition switch off.

(3) Connect the Techstream to the DLC3.

(4) Turn the ignition switch to ON and turn the Techstream ON.

(5) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / AIR PUMP 1: ON, ASV1: OPEN, AIR PUMP 2: ON, ASV2: OPEN and AIR PUMP 1: OFF, ASV1: CLOSE, AIR PUMP 2: OFF, ASV2: CLOSE.

(6) Start the engine after the Techstream initialization is finished.

(7) Perform the AIR system intrusive operation while the engine is idling.

(8) Check that the air-fuel ratio and pressure in the secondary air injection system passage (PULSATION) displayed on the Techstream indicate the conditions shown in the table below.

(9) Turn the ignition switch off.

OK:

AIR System Operation	Pulsation Condition (ECM Calculation)	Air-Fuel Ratio (Reference)
AIR PUMP: ON, ASV: OPEN	15 kPa or more	18 or more
AIR PUMP: OFF, ASV: CLOSE	Less than 30 kPa	Approximately 14.5 (around stoichiometric air-fuel ratio)

Reference:

If the air pump operation is confirmed as normal [Click here for more information.](#), the air-fuel ratio detected in front of three-way catalytic converter changes in response to the secondary air pumped into the exhaust port when the air pump operates.

Result

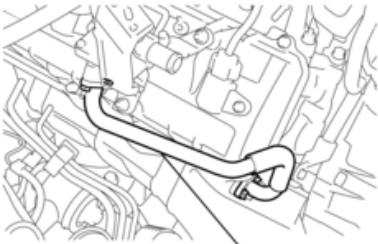
Result	Proceed to
NG	A
OK	B

B	INSPECT VACUUM HOSES (AIR SWITCHING VALVE - PRESSURE SENSOR)
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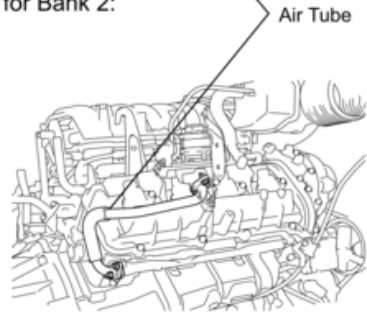
A

3.	INSPECT AIR TUBE (BLOCKAGES AND LEAKAGES)
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for Bank 1:



for Bank 2:



(a) Check that the No. 2 and No. 3 air tubes are securely connected to both the exhaust manifold and the ASV.

(b) Inspect the air tube for blockages and damage.

OK:

No blockages and damage on intake pipe.

Result

Result	Proceed to
OK	A
NG (for Bank 1)	B
NG (for Bank 2)	C

C

▶

[REPLACE AIR TUBE](#)

B

▶

[REPLACE AIR TUBE](#)

A

▼

4.

INSPECT AIR SWITCHING VALVE

(a) Inspect the air switching valve for Bank 1 [Click here for more information.](#)

(b) Inspect the air switching valve for Bank 2 [Click here for more information.](#)

Result

Result	Proceed to
OK	A
NG (for Bank 1)	B
NG (for Bank 2)	C

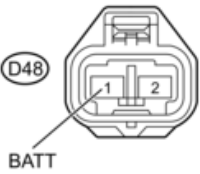
C▶[REPLACE AIR SWITCHING VALVE](#)

B▶[REPLACE AIR SWITCHING VALVE](#)

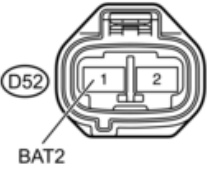
A▼

5.INSPECT AIR INJECTION CONTROL DRIVER (POWER SOURCE OF AIR INJECTION CONTROL DRIVER)

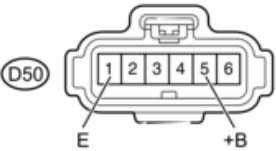
Front view of wire harness connector:
(to AID for Bank 1)



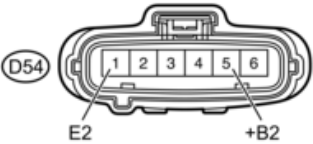
Front view of wire harness connector:
(to AID for Bank 2)



Front view of wire harness connector:
(to AID for Bank 1)



Front view of wire harness connector:
(to AID for Bank 2)



- (a) Disconnect the D48 and D50 or D52 and D54 AID connectors.
- (b) Turn the ignition switch to ON.
- (c) Measure the voltage according to the value(s) in the table below.

Standard voltage:

Tester Connection	Switch Condition	Specified Condition
D48-1 (BATT) - Body ground	Ignition switch ON	11 to 14 V (near battery voltage)
D50-5 (+B) - Body ground	Ignition switch ON	11 to 14 V (near battery voltage)
D52-1 (BAT2) - Body ground	Ignition switch ON	11 to 14 V (near battery voltage)
D54-5 (+B2) - Body ground	Ignition switch ON	11 to 14 V (near battery voltage)

(d) Measure the resistance according to the value(s) in the table below.

Standard resistance:

Tester Connection	Condition	Specified Condition
D50-1 (E) - Body ground	Always	Below 1 Ω
D54-1 (E2) - Body ground	Always	Below 1 Ω

NG

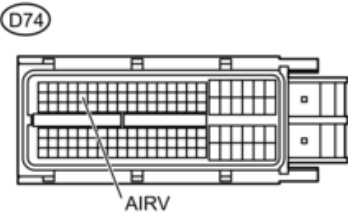
REPAIR OR REPLACE AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT

OK

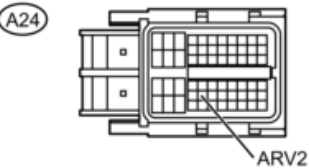
6.

CHECK HARNESS AND CONNECTOR (ECM - AIR INJECTION CONTROL DRIVER)

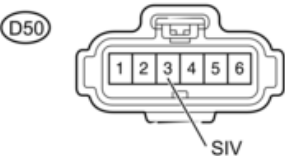
Front view of wire harness connector:
(to ECM)



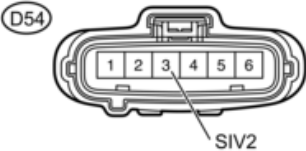
Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to AID for Bank 1)



Front view of wire harness connector:
(to AID for Bank 2)



- (a) Disconnect the A24 or D74 ECM connector.
- (b) Disconnect the D50 or D54 AID connector.
- (c) Measure the resistance according to the value(s) in the table below.

Standard resistance:

Tester Connection	Condition	Specified Condition
D74-28 (AIRV) - D50-3 (SIV)	Always	Below 1 Ω
A24-43 (ARV2) - D54-3 (SIV2)	Always	Below 1 Ω

NG	▶ REPAIR OR REPLACE HARNESS OR CONNECTOR
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7.	REPLACE AIR INJECTION CONTROL DRIVER
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(a) Replace the air injection control driver [Click here for more information.](#)



8.	CHECK WHETHER DTC OUTPUT RECURS (DTC P2440, P2441, P2442 AND/OR P2443)
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- (a) Start the engine and warm it up.
- (b) Turn the ignition switch off.
- (c) Connect the Techstream to the DLC3.
- (d) Turn the ignition switch to ON and turn the Techstream ON.
- (e) Clear DTCs (if set) [Click here for more information.](#)
- (f) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Automatic Mode.
- (g) Start the engine after the Techstream initialization is finished.
- (h) Perform the System Check operation by pressing Next.
- (i) After operating the AIR system, perform the following to confirm the AIR system pending codes: Press the Exit button.
- (j) Check pending DTCs.
- (k) Turn the ignition switch off.

OK:

No pending DTC output.

NOTICE:

- When performing the Air Injection Check operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.
- Turn the ignition switch off when the Air Injection Check operation finishes.



OK	▶	END
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9.	INSPECT VACUUM HOSES (AIR SWITCHING VALVE - PRESSURE SENSOR)
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OK:

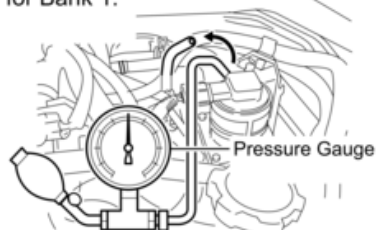
No blockage and no deformation in vacuum hose.

NG	▶	REPAIR OR REPLACE VACUUM HOSE
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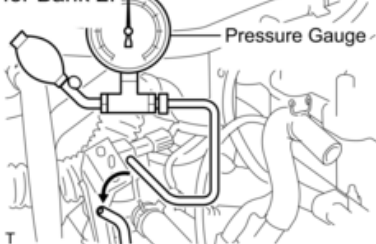
OK
▼

10.	READ VALUE USING AIR SWITCHING VALVE (PRESSURE SENSOR)
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for Bank 1:



for Bank 2:



(a) Connect a pressure gauge to the air pressure sensor as shown in the illustration.

(b) Connect the Techstream to the DLC3.

(c) Turn the ignition switch to ON and turn the Techstream ON.

(d) Enter the following menus: Powertrain / Engine and ECT / Data List / Air pump pressure (absolute) and Air Pump2 Pressure (Absolute).

(e) Check that the pressure displayed on the Techstream fluctuates when applying pressure to the pressure sensor with the pressure gauge.

OK:

Pressure fluctuates in response to pressure applied with pressure gauge.

HINT:

The Techstream displays the air pump pressure as absolute pressure.

Result

Result	Proceed to
OK	A
NG (for Bank 1)	B
NG (for Bank 2)	C

C	▶	REPLACE AIR SWITCHING VALVE
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B	▶	REPLACE AIR SWITCHING VALVE
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A	▶	CHECK FOR INTERMITTENT PROBLEMS
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