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<b>Model Year Start:</b> 2010	<b>Model:</b> GX460	<b>Prod Date Range:</b> [11/2009 -     ]
<b>Title:</b> 1UR-FE ENGINE CONTROL: SFI SYSTEM: P2440-P2443; Secondary Air Injection System Switching Valve Stuck Open Bank1; 2010 MY GX460 [11/2009 -     ]		

<b>DTC</b>	<b>P2440</b>	<b>Secondary Air Injection System Switching Valve Stuck Open Bank1</b>
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<b>DTC</b>	<b>P2441</b>	<b>Secondary Air Injection System Switching Valve Stuck Close Bank1</b>
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<b>DTC</b>	<b>P2442</b>	<b>Secondary Air Injection System Switching Valve Stuck Open Bank 2</b>
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<b>DTC</b>	<b>P2443</b>	<b>Secondary Air Injection System Switching Valve Stuck Closed Bank 2</b>
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## DESCRIPTION

Refer to DTC P0412 [INFO](#) .

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
P2440	The air switching valve (for Bank 1) is stuck open for approximately 60 seconds after the engine is started cold (1 trip detection logic).	<ul style="list-style-type: none"> <li>• Air switching valve assembly</li> <li>• Open or short in air switching valve circuit</li> <li>• Air injection system piping</li> <li>• Pressure sensor</li> <li>• Pressure sensor circuit</li> <li>• Air injection control driver</li> <li>• ECM</li> </ul>
	The air switching valve (for Bank 1) is stuck open for 5 seconds or more while the engine is running (1 trip detection logic).	
P2441	The air switching valve (for Bank 1) is stuck closed for approximately 60 seconds after the engine is started cold (2 trip detection logic).	<ul style="list-style-type: none"> <li>• Air switching valve assembly</li> <li>• Open or short in air switching valve circuit</li> <li>• Air injection system piping</li> <li>• Pressure sensor</li> <li>• Pressure sensor circuit</li> <li>• Air injection control driver</li> <li>• ECM</li> </ul>
	The air switching valve (for Bank 1) is stuck closed for 5 seconds or more while the engine is running (2 trip detection logic).	
P2442	The air switching valve (for Bank 2) is stuck open for approximately 60	<ul style="list-style-type: none"> <li>• Air switching</li> </ul>

DTC NO.	DTC DETECTION CONDITION	TROUBLE AREA
	seconds after the engine is started cold (1 trip detection logic).	valve assembly <ul style="list-style-type: none"> <li>• Open or short in air switching valve circuit</li> <li>• Air injection system piping</li> <li>• Pressure sensor</li> <li>• Pressure sensor circuit</li> <li>• Air injection VSV relay (AI-VSV)</li> <li>• ECM</li> </ul>
	The air switching valve (for Bank 2) is stuck open for 5 seconds or more while the engine is running (1 trip detection logic).	
P2443	The air switching valve (for Bank 2) is stuck closed for approximately 60 seconds after the engine is started cold (2 trip detection logic).  The air switching valve (for Bank 2) is stuck closed for 5 seconds or more while the engine is running (2 trip detection logic).	<ul style="list-style-type: none"> <li>• Air switching valve assembly</li> <li>• Open or short in air switching valve circuit</li> <li>• Air injection system piping</li> <li>• Pressure sensor</li> <li>• Pressure sensor circuit</li> <li>• Air injection VSV relay (AI-VSV)</li> <li>• ECM</li> </ul>

#### HINT:

Air switching valve normal operation:

When the air switching valve is open, exhaust gas pulsation occurs in the secondary air passage.

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

## MONITOR DESCRIPTION

DTCs P2440 and P2442 indicate that the air switching valve is stuck open. DTCs P2441 and P2443 indicate that the air switching valve is stuck closed. The ECM performs diagnosis of the secondary air injection system based on the pressure pulsation when the system is not operating. If a malfunction is detected, the ECM illuminates the MIL and stores a DTC.

## MONITOR STRATEGY

Related DTCs	P2440: Air switching valve stuck open P2441: Air switching valve stuck closed P2442: Air switching valve stuck open P2443: Air switching valve stuck closed
Required Sensors/Components (Main)	Pressure sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per drive cycle
Duration	2 seconds: Case 2 7 seconds: Others
MIL Operation	1 driving cycle: Case 2 2 driving cycles: Others

## TYPICAL ENABLING CONDITIONS

### All

Monitor runs whenever following DTCs not present	P0010, P0020 (VVT oil control valve) P0011, P0021 (VVT system - Advance) P0012, P0022 (VVT system - Retard) P0013, P0023 (Exhaust VVT oil control valve) P0014, P0024 (Exhaust VVT system - Advance) P0015, P0025 (Exhaust VVT system - Retard) P0016, P0018 (VVT system - Misalignment) P0017, P0019 (Exhaust VVT system - Misalignment) P0031, P0032, P0051, P0052, P101D, P103D (Air fuel ratio sensor heater) P006A, P0107, P0108 (Manifold absolute pressure) P0102, P0103 (Mass air flow meter) P0112, P0113 (Intake air temperature sensor) P0115, P0117, P0118 (Engine coolant temperature sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle position sensor) P0125 (Insufficient coolant temperature for closed loop fuel control) P0171, P0172, P0174, P0175 (Fuel system) P0301 - P0308 (Misfire) P0327, P0328, P0332, P0333, P032C, P032D, P033C, P033D (Knock sensor) P0335 (Crankshaft position sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor) P0351 - P0358 (Igniter) P0365, P0367, P0368, P0390, P0392, P0393 (Exhaust VVT sensor) P0401 (EGR system) P0451, P0452, P0453 (EVAP system) P0500, P0722 (Vehicle speed sensor) P106B (Evap. emission control system pressure sensor - Air injection system pressure sensor correlation) P1340 (Camshaft position sensor) P1613 (Secondary air injection driver) P2195, P2196, P2197, P2198, P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255, P2256, P2A00, P2A03 (Front oxygen/Air fuel ratio sensor) P2431, P2432, P02433, P2436, P2437, P2438 (Secondary air injection system pressure sensor)
Battery voltage	11 V or higher
Atmospheric pressure	45 kPa (338 mmHg) or higher
Engine	Running
Pressure pattern check during secondary air injection ON*1	Completed
Pressure pattern check during secondary air injection OFF*2	Completed
Pressure change check: secondary air injection ON*3	Completed

Pressure pulsation check: secondary air injection OFF*4	Completed
Air injection control driver failure (open/short or out of range)	Not detected
Secondary air injection system pressure sensor failure (open/short or out of range)	Not detected

*1: Pressure pattern check during secondary air injection ON	-
Time after secondary air injection starts operation	5 seconds or more
Air pump	ON
Air switching valve	Open
Engine speed	Less than 3750 rpm
Engine speed	400 rpm or more
Intake air amount	Less than 100 g/s/L
Time after engine start	1 second or more

*2: Pressure pattern check during secondary air injection OFF	-
Time after secondary air injection starts operation	10 seconds or more
Air pump	OFF
Air switching valve	Closed
Engine speed	Less than 3000 rpm
Secondary air injection monitor during secondary air injection ON	Completed
Time after engine start	1 second or more

*3: Pressure change check: secondary air injection ON	-
Secondary air injection	Operating
Air pump	ON
Air switching valve (bank 1)	Open
Air switching valve (bank 2)	Closed
Secondary air injection system pressure sensor failure (open/short or out of range)	Not detected
Intake air amount	Less than 15 g/s/L

*4: Pressure pulsation check: secondary air injection OFF	-
Pressure change check: secondary air injection ON	Completed
Pressure pulsation check: secondary air injection OFF	Not completed
Air pump	ON
Time after air switching valve (bank 1) closes	0.3 seconds or more
Air switching valve (bank 2)	Open
Engine speed	Less than 3750 rpm

#### **P2440, P2442 Air Switching Valve is Stuck Open (Case 2)**

One of the following conditions is met	(a), (b) or (c)
(a) Cumulative intake air amount	100 g/s or more
(b) Difference between starting temperature and current temperature	10°C (18°F) or more
(c) Starting coolant temperature	45°C (113°F) or higher
Air pump	OFF
Air switching valve	Closed
Engine speed	5000 rpm or less
Secondary air injection system pressure sensor failure (open/short or out of range)	Not detected
Time after engine started	1 second or more
Time after secondary air injection starts operation	10 seconds or more
Air switching valve stuck open (DTC P2440, P2442)	Not stored
Secondary air injection system pressure sensor stuck off (DTC P2445)	Not in operation
Engine load	20% or more

## **TYPICAL MALFUNCTION THRESHOLDS**

### **P2440 Air Switching Valve is Stuck Open (Case 1)**

One of the following conditions is met	(a), (b) or (c)
(a) Condition 2 (secondary air injection ON) and Condition 2 (secondary air injection OFF)	Met
(b) Condition 1 (secondary air injection ON), Condition 1 (secondary air injection OFF), no pressure change detected when secondary air injection ON and pressure pulsation detected when secondary air injection OFF	Met
(c) Condition 1 (secondary air injection ON), Condition 2 (secondary air injection OFF), no pressure change detected when secondary air injection ON and pressure pulsation detected when secondary air injection OFF	Met

### **P2442 Air Switching Valve is Stuck Open (Case 1)**

One of the following conditions is met	(a), (b) or (c)
(a) Condition 2 (secondary air injection ON) and Condition 2 (secondary air injection OFF)	Met
(b) Condition 1 (secondary air injection ON) and Condition 1 (secondary air injection OFF)	Met
(c) Condition 1 (secondary air injection ON) and Condition 2 (secondary air injection OFF)	Met

### **P2440, P2442 Air Switching Valve is Stuck Open (Case 2)**

Cumulative pressure pulsation	100 kPa or higher
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### **P2441 Air Switching Valve is Stuck Closed**

One of the following conditions is met	(a), (b), (c) or (d)
(a) Condition 3 (secondary air injection ON)	Met

(b) Condition 1 (secondary air injection ON), Condition 3 (secondary air injection OFF), no pressure change detected when secondary air injection ON and pressure pulsation detected when secondary air injection OFF	Met
(c) Condition 1 (secondary air injection ON), Condition 4 (secondary air injection OFF), no pressure change detected when secondary air injection ON and pressure pulsation detected when secondary air injection OFF	Met
(d) Condition 4 (secondary air injection ON)	Met

#### **P2443 Air Switching Valve is Stuck Closed**

One of the following conditions is met	(a), (b) or (c)
(a) Condition 3 (secondary air injection ON)	Met
(b) Condition 1 (secondary air injection ON), pressure change detected when secondary air injection ON and no pressure pulsation detected when secondary air injection OFF	Met
(c) Condition 4 (secondary air injection ON)	Met

#### **Secondary Air Injection ON (Condition 1)**

Both conditions are met during secondary air injection ON	-
Cumulative pressure pulsation	12 kPa or higher
Secondary air injection pressure	1 kPa or higher

#### **Secondary Air Injection ON (Condition 2)**

Both conditions are met during secondary air injection ON	-
Cumulative pressure pulsation	12 kPa or higher
Secondary air injection pressure	Below 1 kPa

#### **Secondary Air Injection ON (Condition 3)**

Both conditions are met during secondary air injection ON	-
Cumulative pressure pulsation	Below 12 kPa
Secondary air injection pressure	1 kPa or higher

#### **Secondary Air Injection ON (Condition 4)**

Both conditions are met during secondary air injection ON	-
Cumulative pressure pulsation	Below 12 kPa
Secondary air injection pressure	Below 1 kPa

#### **Secondary Air Injection OFF (Condition 1)**

Both conditions are met during secondary air injection OFF	-
Cumulative pressure pulsation	20 kPa or higher
Secondary air injection pressure	2.5 kPa or higher

#### **Secondary Air Injection OFF (Condition 2)**

Both conditions are met during secondary air injection OFF	-
Cumulative pressure pulsation	20 kPa or higher
Secondary air injection pressure	Below 2.5 kPa


### Secondary Air Injection OFF (Condition 3)

Both conditions are met during secondary air injection OFF	-
Cumulative pressure pulsation	Below 20 kPa
Secondary air injection pressure	2.5 kPa or higher

### Secondary Air Injection OFF (Condition 4)

Both conditions are met during secondary air injection OFF	-
Cumulative pressure pulsation	Below 20 kPa
Secondary air injection pressure	Below 2.5 kPa

#### HINT:


Refer to "Data List / Active Test" [Air Pump Pressure (Absolute), Air Pump2 Pressure (Absolute) and Air Pump Pulsation Pressure]  .

## MONITOR RESULT

Refer to Checking Monitor Status  .

## CONFIRMATION DRIVING PATTERN

#### NOTICE:

- This Air Injection Check only allows technicians to operate the secondary air injection 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 secondary air injection system operation using the Techstream is prohibited, the Techstream display indicates the prohibition (WAIT or ERROR). If ERROR is displayed on the Techstream during the test, stop the engine for 10 minutes, and then try again.
  - Performing Air Injection Check repeatedly may cause damage to the secondary air injection system. If it is necessary to repeat the check, 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 engine switch turned on (IG) or the engine running.
  - Turn the engine switch off when the Air Injection Check operation finishes.
1. Start the engine and warm it up.
  2. Turn the engine switch off.
  3. Connect the Techstream to the DLC3.
  4. Turn the engine switch on (IG).
  5. Turn the Techstream on.
  6. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation)  .
  7. Turn the engine switch off and wait for at least 30 seconds.
  8. Turn the engine switch on (IG) and turn the Techstream on.
  9. Enter the following menus: Powertrain / Engine and ECT / Utility / Air injection check / Automatic Mode.
  10. Start the engine after the Techstream initialization is finished.
  11. Perform the System Check operation by pressing ENTER (Next).
  12. Perform the following to confirm the secondary air injection system pending codes: Press ENTER (Exit).
  13. Check for pending DTCs.

OK:

No pending DTC is output.

14. After "Air injection check" is completed, check for All Readiness by entering the following menus:  
Powertrain / Engine and ECT / Utility / All Readiness.
15. Input the DTC: P2440, P2441, P2442 or P2443.
16. Check the DTC judgment result.

TECHSTREAM DISPLAY	DESCRIPTION
NORMAL	<ul style="list-style-type: none"><li>• DTC judgment completed</li><li>• System normal</li></ul>
ABNORMAL	<ul style="list-style-type: none"><li>• DTC judgment completed</li><li>• System abnormal</li></ul>
INCOMPLETE	<ul style="list-style-type: none"><li>• DTC judgment not completed</li><li>• Perform driving pattern after confirming DTC enabling conditions</li></ul>
UNKNOWN	<ul style="list-style-type: none"><li>• Unable to perform DTC judgment</li><li>• Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit</li></ul>

**HINT:**

- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.

17. If the judgment result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs INFO.

**HINT:**

- If no permanent DTC is output, the system is normal.
- If a permanent DTC is output, the system is malfunctioning.

18. Turn the engine switch off.

## WIRING DIAGRAM

Refer to DTC P0412 INFO.

## INSPECTION PROCEDURE

**HINT:**

Refer to "Data List / Active Test" [Air Pump Pressure (Absolute), Air Pump2 Pressure (Absolute) and Air Pump Pulsation Pressure] INFO.

**HINT:**

Determination by ECM monitoring:

The ECM locates malfunctions in the secondary air injection system by detecting the pressure in the secondary air injection passage between the air pump and air switching valve and stores a DTC. Soon after a cold engine start, the monitor runs for a short time while the secondary air injection system is both ON and OFF. The ECM detects both the pressure and the exhaust pulsation and compares them.

The following 8 patterns are secondary air injection system pressure conditions in the secondary air injection system passage.

### **Pressure Condition in Secondary Air Injection System Case 1**

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

#### Pressure Condition in Secondary Air Injection System Case 2

Air Pump	OFF
Air Switching Valve	Open
Pressure	Below 2.5 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 higher
Pulsation Detection	Exhaust gas pulsation not detected

#### Pressure Condition in Secondary Air Injection System Case 4

Air Pump	OFF
Air Switching Valve	Closed
Pressure	Below 2.5 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	1 kPa or higher
Pulsation Detection	Exhaust gas pulsation detected

#### Pressure Condition in Secondary Air Injection System Case 6

Air Pump	OFF
Air Switching Valve	Open
Pressure	Below 2.5 kPa
Pulsation Detection	Exhaust gas pulsation detected

#### Pressure Condition in Secondary Air Injection System Case 7

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

## Pressure Condition in Secondary Air Injection System Case 8

Air Pump	OFF
Air Switching Valve	Closed
Pressure	Below 2.5 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 air switching valve is assumed to be open. The ECM locates malfunctions from the combination of pressures detected when the secondary air injection 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 secondary air injection 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 air switching valve, the average pressure is higher than in case 1 (approximately 12 to 20 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 CONDITION WHILE SECONDARY AIR INJECTION OPERATING: AIR PUMP ON, AIR SWITCHING VALVE OPEN	DETECTED CONDITION WHILE SECONDARY AIR INJECTION NOT OPERATING: AIR PUMP OFF, AIR SWITCHING VALVE CLOSED	ECM DETERMINATION	DTC OUTPUT
Case 1	Case 8	Normal	-
Case 1	Case 6	Air switching valve stuck open	P2440 or P2442
Case 1	Case 7	Air pump stuck ON	P2444
Case 2	Case 8	Air pump stuck OFF	P2445 or P2447
Case 3	Case 8	Air switching valve stuck closed	P2441 or P2443
Case 1	Case 5	Air switching valve stuck open and air pump stuck ON	P2440 and/or P2442 and P2444
Case 2	Case 6	Air switching valve stuck open and air pump stuck OFF	P2440 and/or P2442 and P2445 or P2447

DETECTED CONDITION WHILE SECONDARY AIR INJECTION OPERATING: AIR PUMP ON, AIR SWITCHING VALVE OPEN	DETECTED CONDITION WHILE SECONDARY AIR INJECTION NOT OPERATING: AIR PUMP OFF, AIR SWITCHING VALVE CLOSED	ECM DETERMINATION	DTC OUTPUT
Case 3	Case 7	Air switching valve stuck closed and air pump stuck ON	P2441 and/or P2443 and P2444
Case 4	Case 8	Air switching valve stuck closed and air pump stuck OFF	P2441 and/or P2443 and P2445 and/or P2447

#### HINT:

- 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.

- Start the engine and warm it up.
- Turn the engine switch off.
- Connect the Techstream to the DLC3.
- Turn the engine switch on (IG).
- Turn the Techstream on.
- Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / AIR PUMP: ON, ASV 1: OPEN, ASV 2: OPEN and AIR PUMP: OFF, ASV 1: CLOSE, ASV 2: 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.

- Start the engine.
- Perform the secondary air injection system forced operation while the engine is idling.
- Check that the air pump (AIR PUMP), air switching valve (ASV) and pressure in the secondary air injection system passage (PRESSURE) displayed on the Techstream indicate the conditions shown in the table below.

Standard:

TECHSTREAM OPERATION	AIR PUMP	AIR SWITCHING VALVE	PRESSURE*1	PULSATION*2
AIR PUMP: ON, ASV: OPEN	ON	OPEN	1 kPa or higher	12 kPa or higher

TECHSTREAM OPERATION	AIR PUMP	AIR SWITCHING VALVE	PRESSURE*1	PULSATION*2
AIR PUMP: OFF, ASV: CLOSE	OFF	CLOSE	Below 2.5 kPa	Below 20 kPa

\*1: Average pumping pressure (gauge pressure). The pressure should be 1 kPa or higher when the secondary air injection 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 secondary air injection system.

j. Turn the engine switch off.

#### NOTICE:

- This Air Injection Check only allows technicians to operate the secondary air injection 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 secondary air injection system operation using the Techstream is prohibited, the Techstream display indicates the prohibition (WAIT or ERROR). If ERROR is displayed on the Techstream during the test, stop the engine for 10 minutes, and then try again.
- Performing Air Injection Check repeatedly may cause damage to the secondary air injection system. If it is necessary to repeat the check, 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 engine switch turned on (IG) or the engine running.
- Turn the engine switch off when the Air Injection Check operation finishes.

#### HINT:

- Bank 1 refers to the bank that includes the No. 1 cylinder\*.

\*: The No. 1 cylinder is the cylinder which is farthest from the transmission.

- Bank 2 refers to the bank that does not include the No. 1 cylinder.

## PROCEDURE

1.	<b>CHECK FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO SECONDARY AIR INJECTION SYSTEM DTCS)</b>
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- Connect the Techstream to the DLC3.
- Turn the engine switch on (IG).
- Turn the Techstream on.
- Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- Read DTCs and freeze frame data.

#### Result

RESULT	PROCEED TO
P2440, P2441, P2442 and/or P2443	A
P2440 and/or P2441 and P0412	B
P2442 and/or P2443 and P0416 and/or P0417	C
P2440, P2441, P2442 and/or P2443 and other DTCs (except P0412, P0416 and P0417) are output	D

**HINT:**

If any DTCs other than P0412, P0416, P0417, P2440, P2441, P2442 and/or P2443 are output, troubleshoot those DTCs first.

**B** ► **GO TO AIR SWITCHING VALVE INSPECTION  
PROCEDURE (P0412)**

**C** ► **GO TO AIR SWITCHING VALVE INSPECTION  
PROCEDURE (P0416 AND P0417)**

**D** ► **GO TO DTC CHART**

**A**



**2.**

**PERFORM ACTIVE TEST USING TECHSTREAM (SECONDARY AIR INJECTION SYSTEM  
OPERATION)**

(a) Perform a visual check:

- (1) Start the engine and warm it up.
- (2) Turn the engine switch off.
- (3) Disconnect the No. 1 and No. 2 air injection system hoses.
- (4) Connect the Techstream to the DLC3.
- (5) Turn the engine switch on (IG).
- (6) Turn the Techstream on.
- (7) Enter the following menus: Powertrain / Engine and ECT /  
Utility / Air Injection Check / Manual Mode / AIR PUMP: ON,  
ASV1: OPEN, ASV2: OPEN.

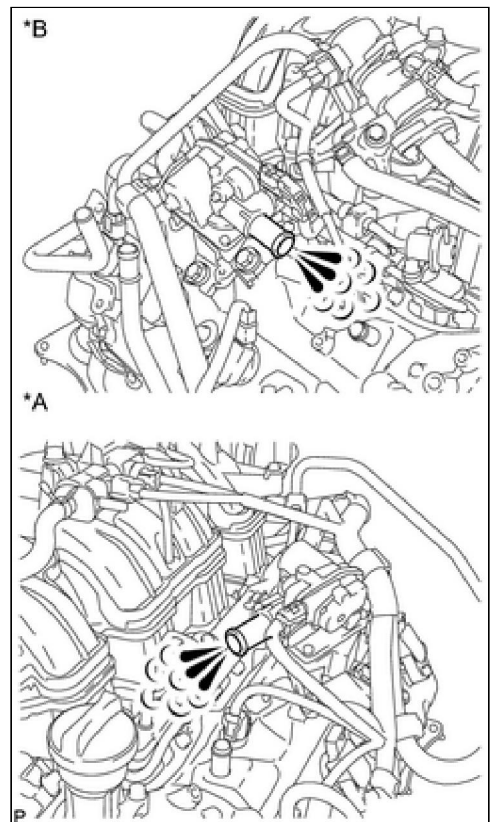
**HINT:**

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

- (8) Start the engine.
- (9) Perform the secondary air injection system forced operation while the engine is idling.
- (10) Place your hand near the air switching valve port and check that the exhaust gas pressure pulsates when the air switching valve is turned on.

**CAUTION:**

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



- (11) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / AIR PUMP: ON, ASV1: OPEN, ASV2: OPEN and AIR PUMP: ON, ASV1: CLOSE, ASV2: CLOSE.
- (12) Check that the exhaust gas does not pulsate when the ASV is turned off.
- (13) Turn the engine switch off.

**NOTICE:**

- This Air Injection Check only allows technicians to operate the secondary air injection 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 secondary air injection system operation using the Techstream is prohibited, the Techstream display indicates the prohibition (WAIT or ERROR). If ERROR is displayed on the Techstream during the test, stop the engine for 10 minutes, and then try again.
- Performing Air Injection Check repeatedly may cause damage to the secondary air injection system. If it is necessary to repeat the check, 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 engine switch turned on (IG) or the engine running.
- Turn the engine switch off when the Air Injection Check operation finishes.

OK:

AIR PUMP OPERATION	AIR SWITCHING VALVE OPERATION	EXHAUST GAS PULSATION
ON	OFF	Not detected
ON	ON	Detected

**Text in Illustration**

*A	Bank 1
*B	Bank 2

**NG**  **GO TO STEP 4**

**OK**  


<b>3.</b>	<b>INSPECT AIR SWITCHING VALVE ASSEMBLY (PRESSURE SENSOR)</b>
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- (a) Connect the Techstream to the DLC3.
- (b) Turn the engine switch on (IG).
- (c) 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 the pressure displayed on the Techstream.

Standard pressure:

45 to 135 kPa

**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

**B** ► REPLACE AIR SWITCHING VALVE ASSEMBLY

**C** ► REPLACE AIR SWITCHING VALVE ASSEMBLY

**A** ► END

**4. INSPECT AIR TUBE (BLOCKAGE AND LEAK)**

(a) Check that the No. 3 and No. 4 air tubes are securely connected to both the exhaust manifold and the air switching valve.

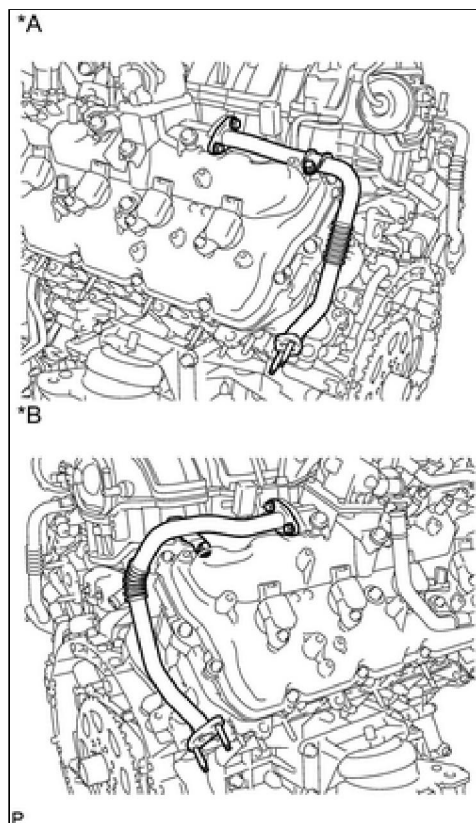
(b) Inspect the air tube for blockages and damage.

OK:

No blockages in or damage to air tubes.

**Text in Illustration**

*A	Bank 1
*B	Bank 2



**NG** ► REPLACE AIR TUBE

OK



**5. INSPECT AIR SWITCHING VALVE ASSEMBLY**

(a) Inspect the air switching valve assembly for bank 1  .

(b) Inspect the air switching valve assembly for bank 2  .

**Result**

RESULT	PROCEED TO
OK	A
NG (for Bank 1)	B
NG (for Bank 2)	C

**B**  **REPLACE AIR SWITCHING VALVE ASSEMBLY**

**C**  **REPLACE AIR SWITCHING VALVE ASSEMBLY**

A



**6. INSPECT AIR INJECTION VSV RELAY (AI-VSV)**

(a) Inspect the air injection VSV relay (AI-VSV)  .

**NG**  **REPLACE AIR INJECTION VSV RELAY (AI-VSV)**

OK



**7. CHECK AIR INJECTION VSV RELAY (AI-VSV) (POWER SOURCE)**

(a) Remove the air injection VSV relay (AI-VSV).

(b) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

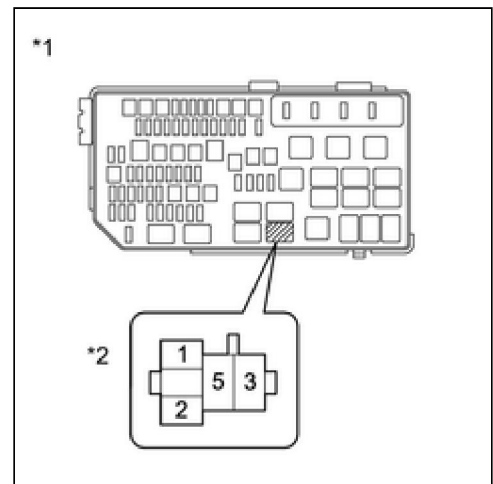
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
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TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Air injection VSV relay (AI-VSV) terminal 2 - Body ground	Always	11 to 14 V

#### Text in Illustration

*1	Engine Room Relay Block
*2	Air Injection VSV Relay (AI-VSV)



(c) Reinstall the air injection VSV relay (AI-VSV).

**NG** REPAIR OR REPLACE HARNESS OR CONNECTOR

**OK**



## 8. CHECK HARNESS AND CONNECTOR (AIR INJECTION VSV RELAY (AI-VSV) - ECM)

- (a) Remove the air injection VSV relay (AI-VSV).
- (b) Disconnect the ECM connector.
- (c) Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Air injection VSV relay (AI-VSV) terminal 1 - C30-20 (AIR1)	Always	Below 1 $\Omega$

Standard Resistance (Check for Short):

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
Air injection VSV relay (AI-VSV) terminal 1 or C30-20 (AIR1) - Body ground	Always	10 k $\Omega$ or higher

- (d) Reinstall the air injection VSV relay (AI-VSV).
- (e) Reconnect the ECM connector.

**NG** REPAIR OR REPLACE HARNESS OR CONNECTOR

**OK**



## 9. INSPECT AIR INJECTION CONTROL DRIVER (POWER SOURCE OF AIR INJECTION

## CONTROL DRIVER)

- (a) Disconnect the air injection control driver connectors.
- (b) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A13-1 (E) - Body ground	Always	Below 1 $\Omega$

### Text in Illustration

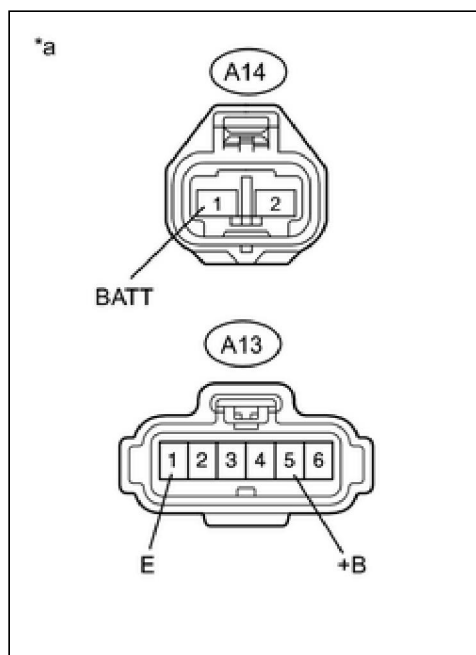
\*a

Front view of wire harness connector  
(to Air Injection Control Driver)

- (c) Turn the engine switch on (IG).
- (d) Measure the voltage according to the value(s) in the table below.

Standard Voltage:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A14-1 (BATT) - Body ground	Always	11 to 14 V (near battery voltage)
A13-5 (+B) - Body ground	Engine switch on (IG)	11 to 14 V (near battery voltage)



**NG** REPAIR OR REPLACE HARNESS OR CONNECTOR

**OK**

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

- (a) Disconnect the ECM connectors.
- (b) Disconnect the air injection control driver connectors.
- (c) Measure the resistance according to the value(s) in the table below.

Standard Resistance:

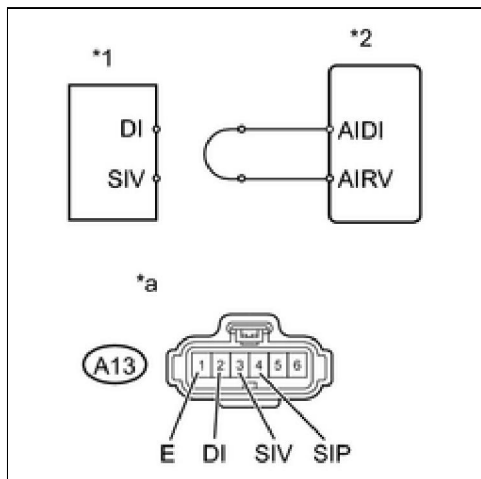
TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
C28-26 (AIRV) - A13-3 (SIV)	Always	Below 1 $\Omega$

**NG** REPAIR OR REPLACE HARNESS OR CONNECTOR



## 11. PERFORM ACTIVE TEST USING TECHSTREAM

(a) Disconnect the air injection control driver connector.



(b) Connect terminals DI and SIV of the wire harness connector for the air injection control driver.

### Text in Illustration

*1	Air Injection Control Driver
*2	ECM
*a	Front view of wire harness connector (to Air Injection Control Driver)

(c) Connect the Techstream to the DLC3.

(d) Turn the engine switch on (IG) and turn the Techstream on.

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

### 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 secondary air injection system forced operation while the engine is idling.

(h) Measure the voltage between the SIV and E terminals of the ECM connector when the secondary air injection system is ON and OFF.

(i) Turn the engine switch off.

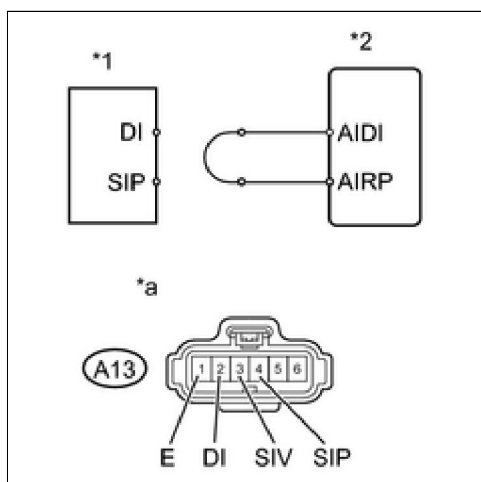
### NOTICE:

- Performing Air Injection Check repeatedly may cause damage to the secondary air injection system. If it is necessary to repeat the check, 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 engine switch turned on (IG) or the engine running.
- Turn the engine switch off when the Air Injection Check operation finishes.

Standard Voltage:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A13-3 (SIV) - A13-1 (E)	AIR PUMP: ON, ASV: OPEN	0.5 to 2 V
A13-3 (SIV) - A13-1 (E)	AIR PUMP: OFF, ASV: CLOSE	11 to 14 V



(j) Connect terminals DI and SIP of the wire harness connector for the air injection control driver.

#### Text in Illustration

*1	Air Injection Control Driver
*2	ECM
*a	Front view of wire harness connector (to Air Injection Control Driver)

(k) Connect the Techstream to the DLC3.

(l) Turn the engine switch on (IG) and turn the Techstream on.

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

#### 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.

(n) Start the engine.

(o) Perform the secondary air injection system forced operation while the engine is idling.

(p) Measure the voltage between the SIP and E terminals of the ECM connector when the secondary air injection system is ON and OFF.

(q) Turn the engine switch off.

#### NOTICE:

- Performing Air Injection Check repeatedly may cause damage to the secondary air injection system. If it is necessary to repeat the check, 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 engine switch turned on (IG) or the engine running.
- Turn the engine switch off when the Air Injection Check operation finishes.

Standard Voltage:

TESTER CONNECTION	CONDITION	SPECIFIED CONDITION
A13-4 (SIP) - A13-1 (E)	AIR PUMP: ON, ASV: OPEN	0.5 to 2 V
A13-4 (SIP) - A13-1 (E)	AIR PUMP: OFF, ASV: CLOSE	11 to 14 V

(r) Reconnect the air injection control driver connector.

**NG**  **REPLACE ECM**

**OK**



<b>12.</b>	<b>REPLACE AIR INJECTION CONTROL DRIVER</b>
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(a) Replace the air injection control driver  .

**NEXT**



<b>13.</b>	<b>CHECK WHETHER DTC OUTPUT RECURS (DTC P2440, P2441, P2442 AND/OR P2443)</b>
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(a) Start the engine and warm it up.

(b) Turn the engine switch off.

(c) Connect the Techstream to the DLC3.

(d) Turn the engine switch on (IG).

(e) Turn the Techstream on.

(f) Clear DTCs (if stored)  .

(g) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Automatic Mode.

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

(i) Perform the System Check operation by pressing ENTER (Next).

(j) Perform the following to confirm the secondary air injection system pending codes: Press the Exit button.

(k) Check pending DTCs.

(l) Turn the engine 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 engine switch turned on (IG) or the engine running.
- Turn the engine switch off when the Air Injection Check operation finishes.

**NG** ► **REPLACE ECM**

**OK** ► **END**

