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|---|---------------------|--------------------------------------|
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| <b>Model Year Start:</b> 2008   | <b>Model:</b> GX470 | <b>Prod Date Range:</b> [07/2007 - ] |
| <b>Title:</b> 2UZ-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P1442,P1445,P2441; Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 1; 2008 MY GX470 [07/2007 - ] |                     |                                      |

|            |              |   |
|------------|--------------|---|
| <b>DTC</b> | <b>P1442</b> | <b>Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 1</b> |
|------------|--------------|---|

|            |              |   |
|------------|--------------|---|
| <b>DTC</b> | <b>P1445</b> | <b>Stuck Close in Secondary Air Injection Vacuum Switching Valve Bank 2</b> |
|------------|--------------|---|

|            |              |   |
|------------|--------------|---|
| <b>DTC</b> | <b>P2441</b> | <b>Secondary Air Injection System Switching Valve Stuck Close Bank1</b> |
|------------|--------------|---|


## DESCRIPTION

Refer to DTC P0412 [INFO](#) .

| DTC NO. | DTC DETECTION CONDITION  | TROUBLE AREA  |
|---------|--|---|
| P1442   | No. 2 air switching valve (bank 1) stuck closed:<br>No pressure change (decrease) after the ECM sends an open No. 2 air switching valve (bank 1) signal.<br>(2 trip detection logic) | <ul style="list-style-type: none"> <li>• VSV for air injection system circuit (bank 1)</li> <li>• Vacuum hose (VSV for air injection system - No. 2 air switching valve)</li> <li>• Air injector pipe (No. 2 air switching valve - exhaust manifold)</li> <li>• No. 2 air switching valve (bank 1)</li> <li>• VSV for air injection system (bank 1)</li> <li>• ECM</li> </ul> |

| DTC NO. | DTC DETECTION CONDITION   | TROUBLE AREA  |
|---------|---|---|
| P1445   | No. 2 air switching valve (bank 2) stuck closed:<br>No pressure change (decrease) after the ECM sends an open No. 2 air switching valve (bank 2) signal.<br>(2 trip detection logic)  | <ul style="list-style-type: none"> <li>• VSV for air injection system circuit (Bank 2)</li> <li>• Vacuum hose (VSV for air injection system - No. 2 air switching valve)</li> <li>• Air injector pipe (No. 2 air switching valve - exhaust manifold)</li> <li>• No. 2 air switching valve (bank 2)</li> <li>• VSV for air injection system (bank 2)</li> <li>• ECM</li> </ul>   |
| P2441   | Air switching valve stuck closed:<br>The pressure sensor does not detect exhaust pulsation when system operates. (All of air switching valve ON)<br>This DTC means either of the following conditions is met. <ol style="list-style-type: none"> <li>1. Electromagnetic air switching valve stuck closed.</li> <li>2. Both of "No. 2 air switching valve (bank 1)" and "No. 2 air switching valve (Bank 2)" are stuck closed.<br/>(2 trip detection logic)</li> </ol> | <ul style="list-style-type: none"> <li>• Vacuum hoses (Throttle body - VSVs for air injection system)</li> <li>• Air switching valve</li> <li>• Air injector pipe (No. 2 air switching valve - exhaust manifold)</li> <li>• Air injection hose</li> <li>• No. 2 air switching valve (bank 1 and/or 2)</li> <li>• VSV for air injection system (bank 1 and/or 2)</li> <li>• Air injection control driver</li> <li>• Air injection control driver circuit</li> <li>• ECM</li> </ul> |

## **MONITOR DESCRIPTION**

Refer to DTC P1441, P1444 and P2440  .

## **MONITOR STRATEGY**

|                                    |  |
|------------------------------------|--|
| Related DTCs                       | (Case 1) P1442 AIR VSV stuck close bank 1<br>(Case 2) P1445 AIR VSV stuck close bank 2<br>(Case 3) P2441 AIR valve stuck close |
| Required sensors/Components (main) | AIR valve, AIR VSV bank 1, AIR VSV bank 2  |
| Required sensors/Components (sub)  | AIR pressure sensor  |
| Frequency of operation             | Once per driving cycle   |

|                    |                   |
|--------------------|-------------------|
| Duration           | Within 20 seconds |
| MIL operation      | 2 driving cycles  |
| Sequence operation | None              |

## **TYPICAL ENABLING CONDITIONS**

|   |  |
|---|--|
| The monitor will run whenever these DTCs are not present        | P0010 - P0022 (VVT system)<br>P0031 - P0052 (A/F sensor heater)<br>P0100 - P0103 (MAF sensor)<br>P0110 - P0113 (IAT sensor)<br>P0115 - P0118 (ECT sensor)<br>P0120 - P0223, P2135 (TP sensor)<br>P0125 (Closed loop)<br>P0171, P0172 (Fuel trim)<br>P0300 - P0308 (Misfire)<br>P0327 - P0333 (Knock sensor)<br>P0335 (CKP sensor)<br>P0340 - P0346 (VVT sensor)<br>P0351 - P0358 (Ignitor)<br>P0455, P0456 (EVAP system)<br>P0450 - P0453 (EVAP press sensor)<br>P0500 (VSS)<br>P2196, P2198 (A/F sensor - rationality)<br>P2237, P2240 (A/F sensor (open) - sensor 1)<br>P2430 - P2433 (AIR pressure sensor)<br>P2A00, P2A03 (A/F sensor - slow response) |
| Atmospheric pressure  | 45 kPa (420 mmHg) or more  |
| Battery voltage   | 11.5 V or higher   |
| AIR monitor runs in accordance with the monitor sequence 1 to 5 | -  |
| Monitor Sequence 1  |  |
| Idle  | ON   |
| AIR status  | ON   |
| AIR pump  | ON   |

|   |                    |
|---|--------------------|
| AIR valve   | ON                 |
| Either of following conditions 1 or 2 is met                | -                  |
| 1. Both of the following conditions are met                 | -                  |
| - AIR valve bank 1  | ON                 |
| - AIR valve bank 2  | OFF                |
| 2. Both of the following conditions are met                 | -                  |
| - AIR valve bank 1  | OFF                |
| - AIR valve bank 2  | ON                 |
| Monitor Sequence 2  |                    |
| Idle  | ON                 |
| AIR status  | ON                 |
| AIR pump  | ON                 |
| AIR valve   | ON                 |
| AIR valve bank 1  | ON                 |
| AIR valve bank 2  | ON                 |
| Monitor Sequence 3  |                    |
| Engine RPM  | Less than 3750 rpm |
| AIR status  | ON                 |
| AIR pump  | ON                 |
| AIR valve   | ON                 |
| AIR valve bank 1  | ON                 |
| AIR valve bank 2  | ON                 |
| Monitor Sequence 4-1  |                    |
| Runs when AIR pressure did not change at monitor sequence 2 |                    |
| Engine RPM  | Less than 3750 rpm |
| AIR status  | OFF                |
|   |                    |

|  |                    |
|--|--------------------|
| AIR pump                                     | ON                 |
| AIR valve                                    | ON                 |
| Either of following conditions 1 or 2 is met | -                  |
| 1. Both of the following conditions are met  | -                  |
| - AIR valve bank 1                           | ON                 |
| - AIR valve bank 2                           | OFF                |
| 2. Both of the following conditions are met  | -                  |
| - AIR valve bank 1                           | OFF                |
| - AIR valve bank 2                           | ON                 |
| Monitor Sequence 4-2                         |                    |
| Engine RPM                                   | Less than 3750 rpm |
| AIR status                                   | OFF                |
| AIR pump                                     | OFF                |
| AIR valve                                    | OFF                |
| AIR valve bank 1                             | OFF                |
| AIR valve bank 2                             | OFF                |
| Monitor Sequence 5                           |                    |
| Engine RPM                                   | Less than 3750 rpm |
| AIR status                                   | OFF                |
| AIR pump                                     | OFF                |
| AIR valve                                    | ON                 |
| AIR valve bank 1                             | OFF                |
| AIR valve bank 2                             | OFF                |

## **TYPICAL MALFUNCTION THRESHOLDS**

**P1442 AIR valve bank 1 close stuck**

|  |                                |
|--|--------------------------------|
| When both conditions below are met:                      | Condition 1 and 2              |
| 1. When one of following conditions is met:              | Condition (a), (b), (c) or (d) |
| (a) When both conditions below are met:                  | Condition (1) and (2)          |
| (1) When both conditions below are met (during AIR ON):  | -                              |
| - Cumulative pressure pulsation                          | Less than 9 kPa                |
| - AIR pressure   | 1 kPa or more                  |
| (2) When both conditions below are met (during AIR OFF): | -                              |
| - Cumulative pressure pulsation                          | Less than 30 kPa               |
| - AIR pressure   | 5 kPa or more                  |
| (b) When both conditions below are met:                  | Condition (1) and (2)          |
| (1) When both conditions below are met (during AIR ON):  | -                              |
| - Cumulative pressure pulsation                          | Less than 9 kPa                |
| - AIR pressure   | 1 kPa or more                  |
| (2) When both conditions below are met (during AIR OFF): | -                              |
| - Cumulative pressure pulsation                          | Less than 20 kPa               |
| - AIR pressure   | Less than 5 kPa                |
| (c) When both conditions below are met:                  | Condition (1) and (2)          |
| (1) When both conditions below are met (during AIR ON):  | -                              |
| - Cumulative pressure pulsation                          | Less than 0 kPa                |
| - AIR pressure   | Less than 1 kPa                |
| (2) When both conditions below are met (during AIR OFF): | -                              |
| - Cumulative pressure pulsation                          | Less than 30 kPa               |
| - AIR pressure   | 5 kPa or more                  |
| (d) When both conditions below are met:                  | Condition (1) or (2)           |
| (1) When both conditions below are met (during AIR ON):  | -                              |
| - Cumulative pressure pulsation                          | Less than 0 kPa                |
|  |                                |

|  |                           |
|--|---------------------------|
| - AIR pressure   | Less than 1 kPa           |
| (2) When both conditions below are met (during AIR OFF):                             | -                         |
| - Cumulative pressure pulsation  | Less than 20 kPa          |
| - AIR pressure   | Less than 5 kPa           |
| 2. When one of following conditions is met:  | Condition (a), (b) or (c) |
| (a) AIR pressure change at monitor sequence 1 (for AIR valve bank 1)                 | Less than 1 kPa           |
| (b) AIR pressure change at monitor sequence 2 (for AIR valve bank 1)                 | Less than 1 kPa           |
| (c) Cumulative pressure pulsation during monitor sequence 4-1 (for AIR valve bank 1) | Less than 15 kPa          |

**P1445 AIR valve bank 2 close stuck**

|  |                                |
|--|--------------------------------|
| When both conditions below are met:                      | Condition 1 and 2              |
| 1. When one of following conditions is met:              | Condition (a), (b), (c) or (d) |
| (a) When both conditions below are met:                  | Condition (1) and (2)          |
| (1) When both conditions below are met (during AIR ON):  | -                              |
| - Cumulative pressure pulsation                          | Less than 9 kPa                |
| - AIR pressure   | 1 kPa or more                  |
| (2) When both conditions below are met (during AIR OFF): | -                              |
| - Cumulative pressure pulsation                          | Less than 30 kPa               |
| - AIR pressure   | 5 kPa or more                  |
| (b) When both conditions below are met:                  | Condition (1) and (2)          |
| (1) When both conditions below are met (during AIR ON):  | -                              |
| - Cumulative pressure pulsation                          | Less than 9 kPa                |
| - AIR pressure   | 1 kPa or more                  |
| (2) When both conditions below are met (during AIR OFF): | -                              |
| - Cumulative pressure pulsation                          | Less than 20 kPa               |
| - AIR pressure   | Less than 5 kPa                |
| (c) When both conditions below are met:                  | Condition (1) and (2)          |

|  |                           |
|--|---------------------------|
| (1) When both conditions below are met (during AIR ON):                              | -                         |
| - Cumulative pressure pulsation  | Less than 0 kPa           |
| - AIR pressure   | Less than 1 kPa           |
| (2) When both conditions below are met (during AIR OFF):                             | -                         |
| - Cumulative pressure pulsation  | Less than 30 kPa          |
| - AIR pressure   | 5 kPa or more             |
| (d) When both conditions below are met:  | Condition (1) or (2)      |
| (1) When both conditions below are met (during AIR ON):                              | -                         |
| - Cumulative pressure pulsation  | Less than 0 kPa           |
| - AIR pressure   | Less than 1 kPa           |
| (2) When both conditions below are met (during AIR OFF):                             | -                         |
| - Cumulative pressure pulsation  | Less than 20 kPa          |
| - AIR pressure   | Less than 5 kPa           |
| 2. When one of following conditions is met:  | Condition (a), (b) or (c) |
| (a) AIR pressure change at monitor sequence 1 (for AIR valve bank 2)                 | Less than 1 kPa           |
| (b) AIR pressure change at monitor sequence 2 (for AIR valve bank 2)                 | Less than 1 kPa           |
| (c) Cumulative pressure pulsation during monitor sequence 4-1 (for AIR valve bank 2) | Less than 15 kPa          |

#### **P2441 AIR valve close stuck**

|  |                   |
|--|-------------------|
| When both conditions below are met (during AIR ON) | Condition 1 and 2 |
| 1. Cumulative pressure pulsation                   | Less than 9 kPa   |
| 2. AIR pressure                                    | 1 kPa or more     |

## **MONITOR RESULT**

Refer to CHECKING MONITOR STATUS  .

## **WIRING DIAGRAM**



Refer to DTC P0412  .

## INSPECTION PROCEDURE

### HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air/fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

## PROCEDURE

### 1. CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO SECONDARY AIR INJECTION SYSTEM DTCS)

- (a) Connect the Techstream to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.
- (d) Read the DTCs.

| DISPLAY (DTC OUTPUT)                             | PROCEED TO |
|--|------------|
| "P1442 and/or P1445" and P2441                   | A          |
| P1442 and/or P1445                               | B          |
| "P1442 and/or P1445 and/or P2441" and other DTCs | C          |

### HINT:

If any DTCs other than P1441 and/or P1444 and P2440 are output, troubleshoot those DTCs first.

**B**  **GO TO STEP 5**

**C**  **GO TO DTC CHART**

**A**

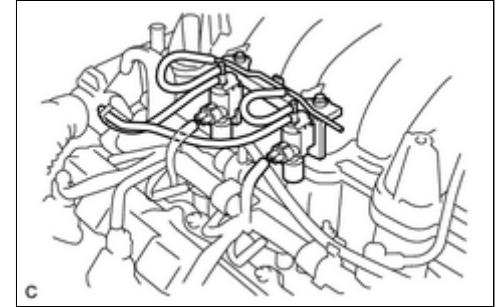


## 2. CHECK VACUUM HOSES (THROTTLE BODY - VSV FOR AIR INJECTION SYSTEM)

(a) Check that the vacuum hoses between the throttle body and VSV for air injection system are securely connected.

OK:

The vacuum hoses are securely connected.



(b) Inspect the vacuum hoses for blockages and damage.

OK:

The vacuum hoses have no blockages and damage.

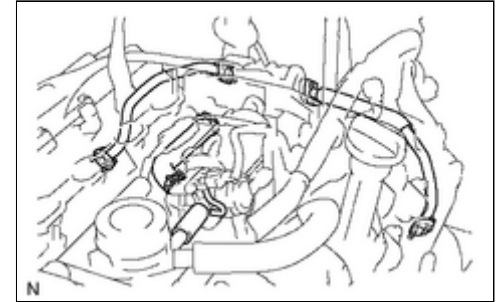
**NG** ► REPAIR OR REPLACE VACUUM HOSES

**OK**



## 3. CHECK PIPES AND HOSES (CONNECTION OF AIR INJECTION SYSTEM)

(a) Remove the intake manifold **INFO** .



(b) Check all pipes and hoses of the air injection system.

OK:

All air injection pipes and hoses are securely connected.

(c) Check all pipes and hoses of the air injection system for blockage or damage.

OK:

All air injection pipes or hoses have no blockages or damage.

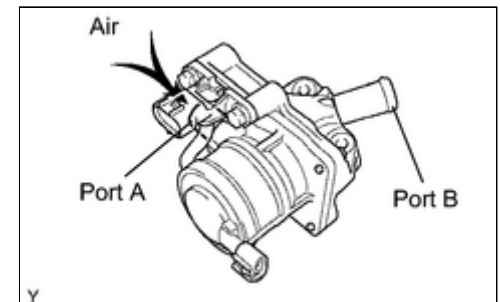
**NG** ► **REPAIR OR REPLACE AIR INJECTION SYSTEM PIPING AND HOSES**

**OK**



**4. CHECK AIR SWITCHING VALVE (OPERATION)**

(a) Remove the intake manifold **INFO** .



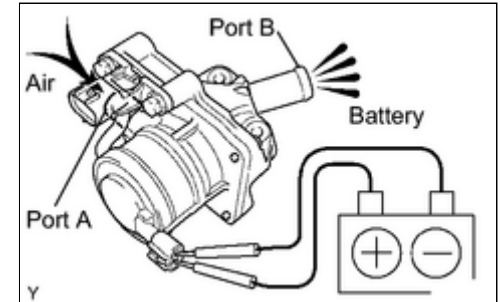
(b) Remove the Air Switching Valve (ASV).

(c) Blow air into port A and check that air is not discharged from port B.

OK:

Not discharged

(d) Apply battery positive voltage across the terminals.



(e) Blow air into port A and check that air is discharged from port B.

OK:

Discharged

**NG** ► REPLACE AIR SWITCHING VALVE AND GO TO STEP 6

**OK**



|           |  |
|-----------|--|
| <b>5.</b> | <b>CHECK NO. 2 AIR SWITCHING VALVE (OPERATION)</b> |
|-----------|--|

(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 ON and turn the tester ON.

(e) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / Operation 5 and 6.

**HINT:**

Operation 5: AP: ON; EASV: OPEN; ASV1: OPEN; ASV2: CLOSE

Operation 6: AP: ON; EASV: OPEN; ASV1: CLOSE; ASV2: OPEN

**NOTICE:**

- This test only allows technicians to operate the AIR system for 5 seconds. Furthermore, the test can be performed 4 times a trip. If the test is repeated, intervals of at least 30 seconds are required between tests.

While the AIR system operation using the Techstream is prohibited, the tester displays the prohibition (WAIT or ERROR). If ERROR (AI STATUS NG) is displayed on the tester, stop the engine for 10 minutes and then try again.

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

(f) Read values of the Air fuel ratio on the Techstream.

|                                     |                    |
|-------------------------------------|--------------------|
| Air switching valve No. 2 operation | Air fuel ratio     |
| Open                                | 18 or more         |
| Closed                              | Approximately 14.5 |

**HINT:**

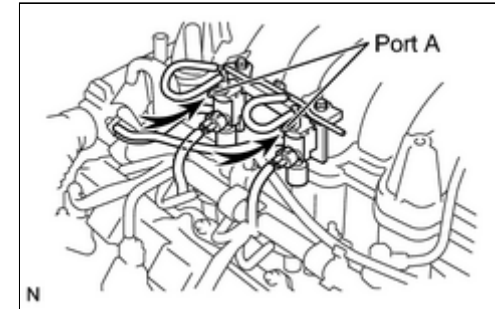
- When the No. 2 ASV operates normally, the A/F value is 18 or more when the valve is open, and approximately 14.5 when the valve is closed.
- Perform the following procedures only on the bank of which the valve is not open.

**NEXT**



|           |   |
|-----------|---|
| <b>6.</b> | <b>CHECK VSV (FOR AIR INJECTION SYSTEM)</b> |
|-----------|---|

(a) Turn the ignition switch OFF.



- (b) Disconnect the vacuum hoses from the VSV for the air injection system.
- (c) Connect the Techstream to the DLC3.
- (d) Start the engine and turn the tester ON.
- (e) When the air switching valve is operated using the Techstream, check that negative pressure from port A.
- (f) Enter the following menus: Powertrain / Engine and ECT / Utility / Air Injection Check / Manual Mode / Operation 2.

**HINT:**

Operation 2: AP: ON; EASV: OPEN; ASV1: OPEN; ASV2: OPEN

**NOTICE:**

- This test only allows technicians to operate the AIR system for 5 seconds. Furthermore, the test can be performed 4 times a trip. If the test is repeated, intervals of at least 30 seconds are required between tests.

While the AIR system operation using the Techstream is prohibited, the tester displays the prohibition (WAIT or ERROR). If ERROR (AI STATUS NG) is displayed on the tester, stop the engine for 10 minutes and then try again.

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

OK:

Negative pressure from port A

- (g) Reconnect the vacuum hose.

**NG**  **GO TO STEP 10**

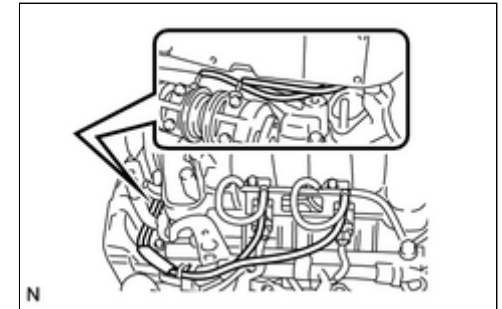
**OK**



**7. CHECK VACUUM HOSES (AIR SWITCHING VALVE - VSV FOR AIR INJECTION SYSTEM)**

(a) Check that the vacuum hoses between the No. 2 air switching valve(s) and VSV for the air injection system are securely connected.

OK:  
The vacuum hose(s) are securely connected.



(b) Check the vacuum hoses for blockages and damage.

OK:  
The vacuum hoses have no blockages and damage.

**NG** ► **REPAIR OR REPLACE VACUUM HOSES**

**OK**

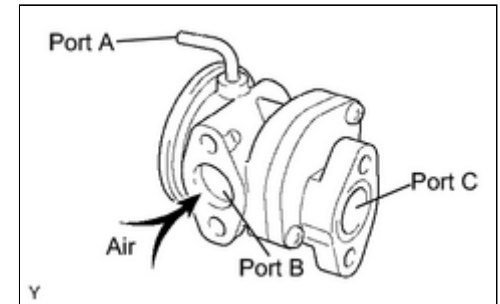


**8. CHECK NO. 2 AIR SWITCHING VALVE (OPERATION)**

(a) Remove the No. 2 air switching valve.

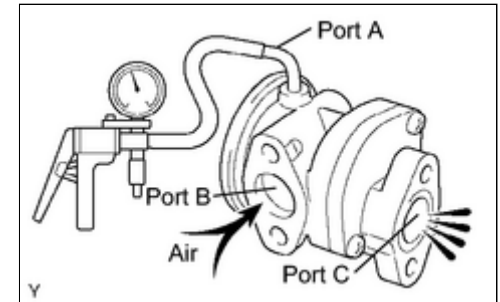
(b) Blow air into port B and check that air is not discharged from port C.

OK:  
Not discharged from port C



(c) Apply vacuum 30 kPa (225 mmHg) to port A, blow air into port B and check that air is discharged from port C.

OK:  
Discharged from port C



**NG** ► REPLACE NO. 2 AIR SWITCHING VALVE

**OK**



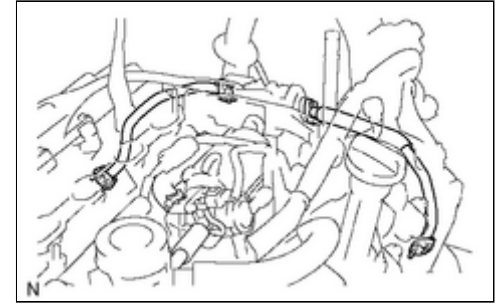
|           |  |
|-----------|--|
| <b>9.</b> | <b>CHECK AIR INJECTION PIPE (NO. 2 AIR SWITCHING VALVE - EXHAUST MANIFOLD)</b> |
|-----------|--|

(a) Check that the air injection pipe between the No. 2 air switching valve(s) and exhaust manifold are securely connected.

OK:



The air injection pipe is securely connected.



(b) Check the air injection pipe for blockages and damage.

OK:

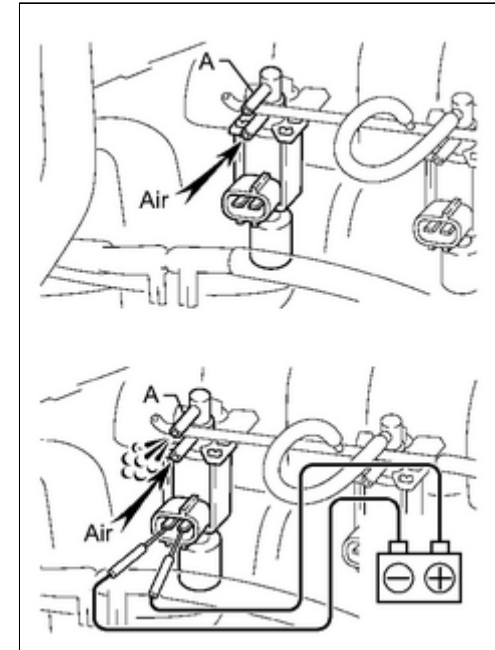
The air injection pipe has no blockages and damage.

**NG** ► REPAIR OR REPLACE AIR INJECTION PIPE

**OK** ► CHECK FOR INTERMITTENT PROBLEMS

|            |   |
|------------|---|
| <b>10.</b> | <b>CHECK VSV (FOR AIR INJECTION SYSTEM)</b> |
|------------|---|

(a) Disconnect the 2 vacuum hoses.



(b) Disconnect the VSV for the air injection system connector.

(c) Blow air into port B. Check that air does not flow from port A.

OK:

Air does not flow from port A

(d) Apply battery positive voltage across the terminals. Then blow air into port B and check that air flows from port A.

OK:

Air flows from port A

**NG** ► REPLACE VSV

**OK** ► REPLACE ECM