

<b>DTC</b>	<b>P1442</b>	<b>Secondary Air Injection System Switching Valve No.2 Stuck Close Bank 1</b>
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<b>DTC</b>	<b>P1445</b>	<b>Secondary Air Injection System Switching Valve No.2 Stuck Close Bank 2</b>
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<b>DTC</b>	<b>P2441</b>	<b>Secondary Air Injection System Switching Valve Stuck Close Bank 1</b>
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## CIRCUIT DESCRIPTION

Refer to DTC P0412 on page [DI-656](#).

DTC No.	DTC Detection Condition	Trouble Area
P1442	<b>Air switching valve No.2 (bank 1) stuck close:</b> No pressure change (decrease) after the ECM sends an open air switching valve No.2 (bank 1) signal. (2 trip detection logic)	<ul style="list-style-type: none"> <li>• VSV for air injection control circuit (Bank 1)</li> <li>• Vacuum hose (VSV for air injection control – air switching valve No.2)</li> <li>• Air injector pipe (Air switching valve No.2 – exhaust manifold)</li> <li>• Air switching valve No.2 (Bank 1)</li> <li>• VSV for air injection control (Bank 1)</li> <li>• ECM</li> </ul>
P1445	<b>Air switching valve No.2 (bank 2) stuck close:</b> No pressure change (decrease) after the ECM sends an open air switching valve No.2 (bank 2) signal. (2 trip detection logic)	<ul style="list-style-type: none"> <li>• VSV for air injection control circuit (Bank 2)</li> <li>• Vacuum hose (VSV for air injection control – air switching valve No.2)</li> <li>• Air injector pipe (Air switching valve No.2 – exhaust manifold)</li> <li>• Air switching valve No.2 (Bank 2)</li> <li>• VSV for air injection control (Bank 2)</li> <li>• ECM</li> </ul>
P2441	<b>Air switching valve stuck close:</b> The pressure sensor does not detect exhaust pulsation when system operates. (All of air switching valve ON) This DTC means either of following conditions. (a) Electromagnetic air switching valve stuck closed. (b) Both of "air switching valve No.2 bank 1" and "air switching valve No.2 bank 2" stuck closed. (2 trip detection logic)	<ul style="list-style-type: none"> <li>• Vacuum hoses (Throttle body – VSVs for air injection control)</li> <li>• Air switching valve</li> <li>• Air injector pipe (Air switching valve No.2 – exhaust manifold)</li> <li>• Air injection hose</li> <li>• Air switching valve No.2 (Bank 1 and/or 2)</li> <li>• VSV for air injection control (Bank 1 and/or 2)</li> <li>• Air injection driver</li> <li>• Air injection driver circuit</li> <li>• ECM</li> </ul>

## MONITOR DESCRIPTION

Refer to DTC P1441, P1444 and P2440 on page [DI-739](#).

## MONITOR STRATEGY

Related DTCs	P1442	AIR VSV (Bank 1) is stuck close (case 1)
	P1444	AIR VSV (Bank 2) is stuck close (case 2)
	P2441	AIR valve stuck close (case 3)
Required sensors/components	AIR pressure sensor, AIR valve, AIR VSV (Bank 1), AIR VSV (Bank 2)	
Frequency of operation	Once per driving cycle	
Duration	Within 60 seconds	
MIL operation	2 driving cycles	
Sequence of operation	None	

## TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever these DTCs are not present	See page <a href="#">DI-437</a>	
Atmospheric pressure	45 kPa (338 mmHg)	–
Battery voltage	11.5 V	–
Sequence 1 to 6 are performed to monitor AIR	–	
Sequence 1	–	
AIR	In operation	
AIR pump	ON	
AIR valve (Electric type)	ON	
Either of the following conditions is met:	Condition 1 or 2	
1. Both of the following conditions are met:	Condition (a) and (b)	
(a) AIR valve (vacuum type) bank 1	ON	
(b) AIR valve (vacuum type) bank 2	OFF	
2. Both of the following conditions are met:	Condition (c) and (d)	
(c) AIR valve (vacuum type) bank 1	OFF	
(d) AIR valve (vacuum type) bank 2	ON	
Idle	ON	
Sequence 2	–	
AIR valve (Electric type)	ON	
AIR valve (vacuum type) bank 1	ON	
AIR valve (vacuum type) bank 2	ON	
Idle	ON	
Sequence 3	–	
AIR pump	ON	
AIR valve (Electric type)	ON	
AIR valve (vacuum type) bank 1	ON	
AIR valve (vacuum type) bank 2	ON	
Engine RPM	–	3750 rpm
Sequence 4 (This sequence is run when AIR pressure is no change at monitor)	–	
AIR	Not operating	
AIR pump	ON	

AIR valve (Electric type)	ON	
Either of the following conditions is met:	Condition 1 or 2	
1. Both of the following conditions are met:	Condition (a) and (b)	
(a) AIR valve (vacuum type) bank 1	ON	
(b) AIR valve (vacuum type) bank 2	OFF	
2. Both of the following conditions are met:	Condition (c) and (d)	
(c) AIR valve (vacuum type) bank 1	OFF	
(d) AIR valve (vacuum type) bank 2	ON	
Engine RPM	–	3750 rpm
Sequence 5	–	
AIR	Not operating	
AIR pump	OFF	
AIR valve (Electric type)	OFF	
AIR valve (vacuum type) bank 1	OFF	
AIR valve (vacuum type) bank 2	OFF	
Engine RPM	–	3750 rpm
Sequence 6	–	
AIR status	Not operating	
AIR pump	OFF	
AIR valve (Electric type)	ON	
AIR valve (vacuum type) bank 1	OFF	
AIR valve (vacuum type) bank 2	OFF	
Engine RPM	–	3750 rpm

## TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
<b>Thresholds for case 1</b>	
Both of the following conditions are met:	Condition 1 or 2
1. One of the following conditions is met:	Condition (a), (b), (c) or (d)
(a) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	5 kPa (37.5 mmHg) or more and pulse is NOT generated
(b) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	Less than 5 kPa (37.5 mmHg) and pulse is NOT generated
(c) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	Less than 1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	5 kPa (37.5 mmHg) or more and pulse is NOT generated
(d) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	Less than 1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	Less than 5 kPa (37.5 mmHg) and pulse is NOT generated
2. One of the following conditions is met:	Condition (e), (f) or (g)
(e) AIR pressure during monitor sequence 1 (when AIR VSV bank 1 is open)	No change
(f) AIR pressure during monitor sequence 2 (when AIR VSV bank 1 is open)	No change

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(g) AIR pressure during monitor sequence 4 (when AIR VSV bank 1 is open)	No pulse is generated
<b>Thresholds for case 2</b>	
Both of the following conditions are met:	Condition 1 or 2
1. One of the following conditions is met:	Condition (a), (b), (c) or (d)
(a) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	5 kPa (37.5 mmHg) or more and pulse is NOT generated
(b) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	Less than 5 kPa (37.5 mmHg) and pulse is NOT generated
(c) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	Less than 1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	5 kPa (37.5 mmHg) or more and pulse is NOT generated
(d) All of the following conditions are met:	–
AIR pressure during monitor sequence 3	Less than 1 kPa (7.5 mmHg) or more and pulse is NOT generated
AIR pressure during monitor sequence 6	Less than 5 kPa (37.5 mmHg) or more and pulse is NOT generated
2. One of the following conditions is met:	Condition (e), (f) or (g)
(e) AIR pressure during monitor sequence 1 (when AIR VSV bank 2 is open)	No change
(f) AIR pressure during monitor sequence 2 (when AIR VSV bank 2 is open)	No change
<b>Thresholds for case 3</b>	
AIR pressure during monitor sequence 3	1 kPa (7.5 mmHg) or more and pulse is NOT generated
(g) AIR pressure during monitor sequence 4 (when AIR VSV bank 2 is open)	No pulse is generated

## MONITOR RESULT

Refer to page [DI-445](#) for detailed information.

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (refer to "Confirmation Monitor").

- MID (Monitor Identification Data) is assigned to each emissions-related component.
- TID (Test Identification Data) is assigned to each test value.
- Scaling is used to calculate the test value indicated on generic OBD II scan tools.

### Secondary air injection (AIR) system

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
\$71	\$E1	Multiply by 0.01 (g/s)	Test value of AIR amount insufficient	Minimum test limit	Maximum test limit
\$71	\$E2	Multiply by 0.01 (kPa)	Test value of AIR pump stuck ON	Minimum test limit	Maximum test limit
\$71	\$E3	Multiply by 0.01 (kPa)	Test value of AIR pump stuck OFF	Minimum test limit	Maximum test limit
\$71	\$E4	Multiply by 0.01 (kPa)	Test value of AIR control valve ON	Minimum test limit	Maximum test limit
\$71	\$E5	Multiply by 0.01 (kPa)	Test value of AIR control valve OFF	Minimum test limit	Maximum test limit
\$71	\$E6	Multiply by 0.01 (kPa)	Test value of AIR pressure change for AIR valve	Minimum test limit	Maximum test limit
\$71	\$E7	Multiply by 0.01 (kPa)	Test value of AIR pressure change for AIR VSV bank 1	Minimum test limit	Maximum test limit
\$71	\$E8	Multiply by 0.01 (kPa)	Test value of AIR pressure change for AIR VSV bank 2	Minimum test limit	Maximum test limit
\$71	\$E9	Multiply by 0.01 (kPa)	Test value of AIR pressure pulsation for AIR VSV when AIR pressure is low	Minimum test limit	Maximum test limit

## WIRING DIAGRAM

Refer to DTC P1441, P1444 and P2440 on page [DI-739](#).

## INSPECTION PROCEDURE

1	<b>Check any other DTCs output (In addition to secondary air injection system DTCs).</b>
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### PREPARATION:

- Connect a hand-held tester to the DLC3.
- Turn the ignition switch to ON and turn the tester ON.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

### CHECK:

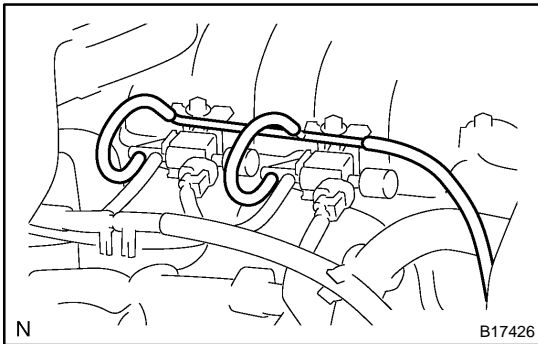
- Read DTCs.

### RESULT:

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:

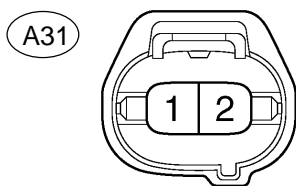
If any DTCs other than P1441 and/or P1444 and P2440 are output, troubleshoot those DTCs first.

**B****Go to step 6.****C****Go to DTC chart (See page [DI-462](#)).****A****2****Check vacuum hose between throttle body and VSV for air injection control.****CHECK:**

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

**OK:****The vacuum hoses are securely connected.****CHECK:**

- (a) Inspect the vacuum hoses for blockages and damage.

**OK:****The vacuum hoses no blockages and damages.****NG****Repair or replace vacuum hoses.****OK****3****Check voltage between terminal 1 of air switching valve and body ground.****Wire Harness Side:****Air Switching Valve Connector****PREPARATION:**

- (a) Remove the intake manifold (see page [EM-36](#)).  
 (b) Disconnect the A31 air switching valve connector.  
 (c) Connect the hand-held tester to the DLC3.  
 (d) Turn the ignition switch ON and turn the tester ON.

**CHECK:**

- (a) When the air switching valve is operated using the hand-held tester, measure voltage between terminal A31-1 of the air switching valve connector and body ground.  
 (b) Select the following menu items: DIAGNOSIS/ENHANCED OBD II/SYSTEM CHECK/AIR INJ CHECK/MANUAL OPERATION/OPERATION 1 and 4

**HINT:**

OPERATION 1: AP:OFF, EASV:CLOSE, ASV1:CLOSE, ASV2:CLOSE

OPERATION 4: AP:OFF, EASV:OPEN, ASV1:CLOSE, ASV2:CLOSE

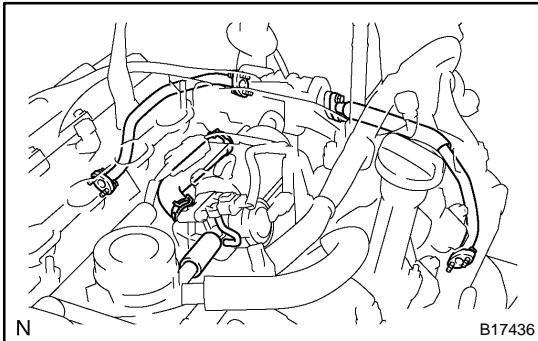
**NOTICE:**

This test only allows technicians to operate the AI 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 AI system operation using the hand-held tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If the ERROR (AI STATUS NG) is displayed on the tester, stop the engine for 10 minutes and then try again..

**OK:****Standard:**

Tester operation	Tester Connection	Specified Condition
Operation 4	A31-1 – Body ground	10 V or more
Operation 1	A31-1 – Body ground	Below 1.0 V

**NG****Go to step 12.****OK****4****Check all air injection pipes and hoses of air injection system.****CHECK:**

- (a) Remove the intake manifold (see page [EM-36](#)).
- (b) Check all pipes and hoses of the air injection system.

**OK:**

**All the air injection pipes and hoses are securely connected.**

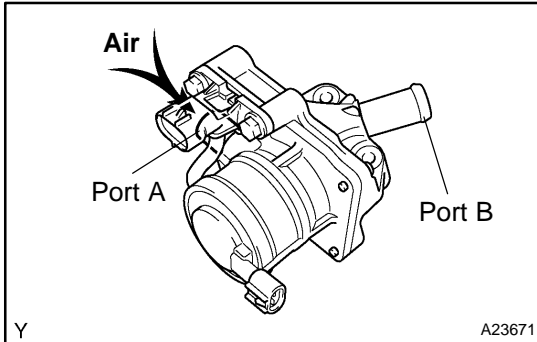
**CHECK:**

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

**OK:**

**The air injection system pipes and hoses have no blockage or damage.**

**NG****Repair or replace pipe or hose.****OK**

**5 Check air switching valve operation.****PREPARATION:**

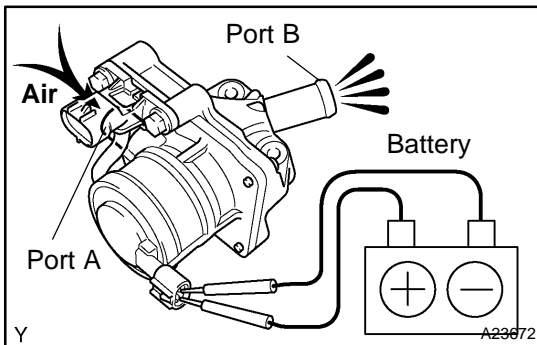
- (a) Remove the intake manifold (see page [EM-36](#)).
- (b) Remove the air switching valve.

**CHECK:**

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

**OK:**

**Not discharged**

**CHECK:**

- (a) Apply battery positive across the terminals.
- (b) 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**



## 6 Check air switching valve No.2 operation.

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AIR INJ CHECK
AIR PUMP.....ON
EASV .....OPEN
ASV1. ....OPEN
ASV2.....OPEN
A/F BANK1.....19.05
A/F BANK2.....14.5
PRESSURE.....17 kPa
PULSATION.....25.39 kPa
AI STATUS.....OK
Remaining Time 05 sec.

Press [EXIT] to quit

```

A16555

**PREPARATION:**

- Start the engine and warm it up.
- Turn the ignition switch to OFF.
- Connect the hand-held tester to the DLC3.
- Turn the ignition switch to ON and push the hand-held tester main switch ON.

**CHECK:**

- Select the following menu items: DIAGNOSIS/ENHANCED OBD II/SYSTEM CHECK/ AIR INJ CHECK/ MANUAL OPERATION/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 AI 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 AI system operation using the hand-held tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If the ERROR (AI STATUS NG) is displayed on the tester, stop the engine for 10 minutes and then try again..**

- Read value of the A/F BANK1 and BANK2 on the hand-held tester.

**RESULT:**

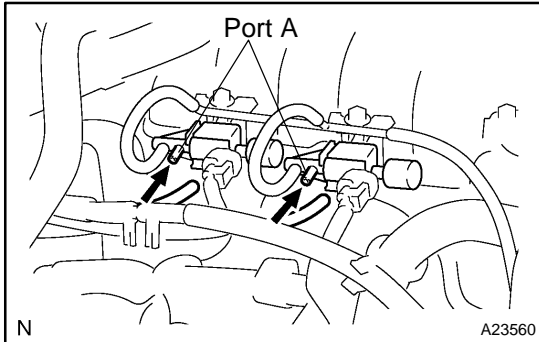
Air switching valve No.2 operation	Air-fuel ratio
Open	18 or more
Close	Approximately 14.5

**HINT:**

- When the ASV No.2 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**

## 7 Check VSV for air injection control operation.



### PREPARATION:

- Turn the ignition switch OFF.
- Disconnect the vacuum hose from the VSV for air injection control.
- Connect the hand-held tester to the DLC3.
- Turn the ignition switch to ON and turn the tester ON.

### CHECK:

- When the air switching valve is operated using the hand-held tester, check that negative pressure from the port A.
- Select the following menu items: DIAGNOSIS/ENHANCED OBD II/SYSTEM CHECK/ AIR INJ CHECK/ MANUAL OPERATION/OPERATION 2

### HINT:

OPERATION 2: AP: ON, EASV:OPEN, ASV1:OPEN, ASV2:OPEN

### NOTICE:

This test only allows technicians to operate the AI 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 AI system operation using the hand-held tester is prohibited, the tester displays the prohibition (WAIT or ERROR). If the ERROR (AI STATUS NG) is displayed on the tester, stop the engine for 10 minutes and then try again..

### OK:

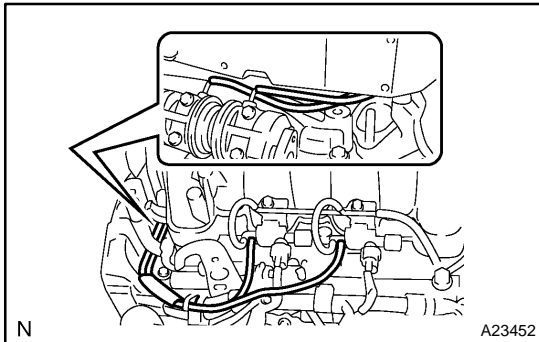
Negative pressure from port A

NG

Go to step 10.

OK

# 8 Check vacuum hose between air switching valve(s) No.2 and VSV for air injection control.



## CHECK:

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

## OK:

The vacuum hose(s) are securely connected.

## CHECK:

- (a) Check the vacuum hoses for blockages and damage.

## OK:

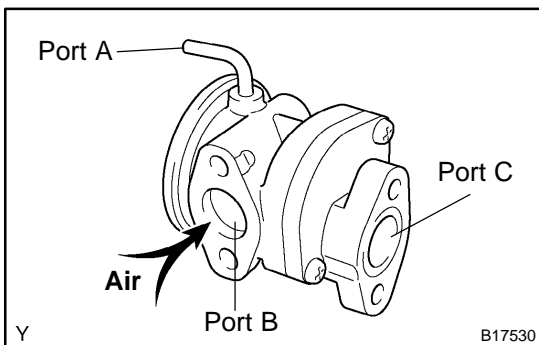
The vacuum hoses no blockages and damages.

NG

Repair or replace vacuum hose.

OK

# 9 Check air switching valve No.2 operation.



## PREPARATION:

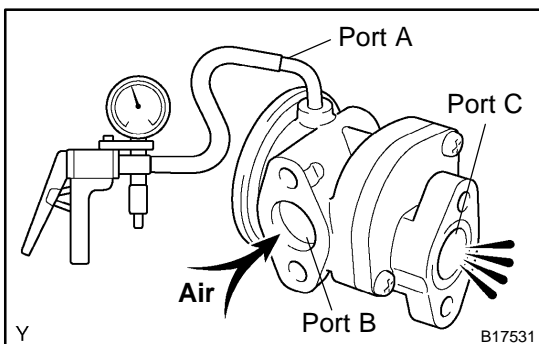
Remove the air switching valve No.2.

## CHECK:

Blow air into port B and check that air is not discharged from the port C.

## OK:

Not discharged from port C



## CHECK:

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

## OK:

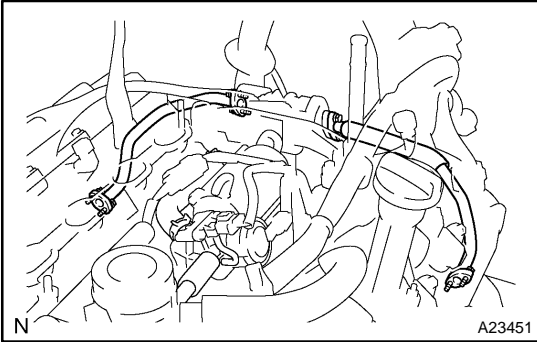
Discharged from port C

NG

Replace air switching valve No.2.

OK

# 10 Check air injection pipe between air switching valve No.2 and exhaust manifold.

**CHECK:**

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

**OK:**

The air injection pipe is securely connected.

**CHECK:**

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

**OK:**

The air injection pipe no blockages and damages.

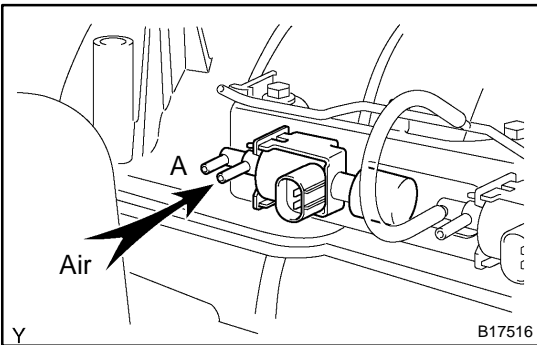
**NG**

Repair or replace air injection pipe.

**OK**

Check for intermittent problems  
(See page [DI-430](#)).

# 11 Check VSV for air injection control.

**PREPARATION:**

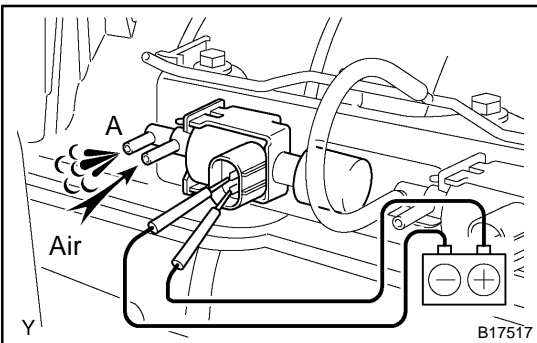
Disconnect the 2 vacuum hoses.

**CHECK:**

Check that air does not flow from the port A as shown in the illustration.

**OK:**

Not flow from port A

**CHECK:**

Apply battery positive across the terminals, check that air flows from the port A.

**OK:**

Flow from port A

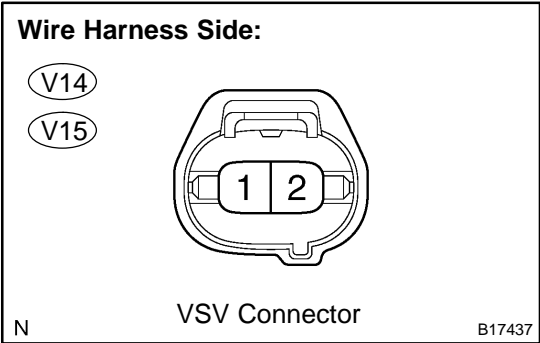
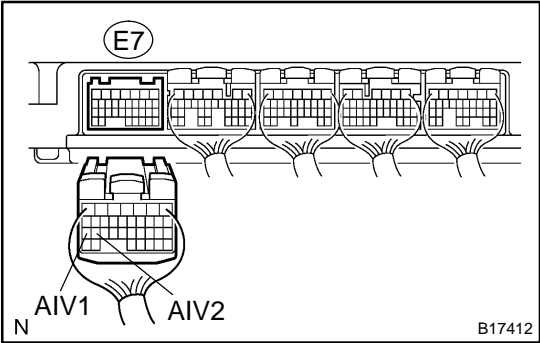
**NG**

Replace VSV for air injection control.

**OK**

12

Check for open and short circuit in harness and connector between ECM and VSV for air injection system control



**PREPARATION:**

- (a) Remove the intake manifold (see page EM-36).
- (b) Disconnect the E7 ECM connector.
- (c) Disconnect the VSV for air injection system control connector.

**CHECK:**

Measure the resistance between the VSV connector and ECM.

**OK:**

**Standard:**

Tester connection	Specified condition
E7-27 (AIV1) – V14-2	Below 1 Ω
E7-26 (AIV2) – V15-2	Below 1 Ω

**CHECK:**

Measure the resistance between the VSV connector and body ground.

**OK:**

**Standard:**

Tester connection	Specified condition
E7-27 (AIV1) or V14-2 and Body ground	10 KΩ or higher
E7-26 (AIV2) or V15-2 and Body ground	10 KΩ or higher

NG

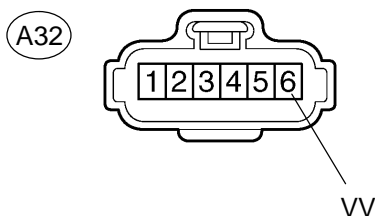
Repair or replace harness or connector.

OK

# 13 Check for open and short in harness and connector between air injection driver and air switching valve.

## Wire Harness Side:

Air Injection Driver Connector



N

B17444

## PREPARATION:

- Remove the intake manifold (see page [EM-36](#)).
- Disconnect the A32 air injection driver connector.
- Disconnect the A31 air switching valve connector.

## CHECK:

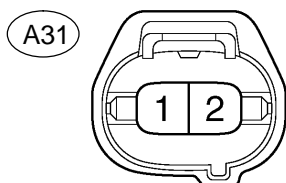
Measure the resistance between the wire harness side connectors.

## OK:

### Standard:

Tester Connection	Specified Condition
VV (A32-6) – A31-1	Below 1 $\Omega$
VV (A32-6) or A31-1 – Body ground	10 k $\Omega$ or higher

## Wire Harness Side:



N

B17440

Air Switching Valve Connector

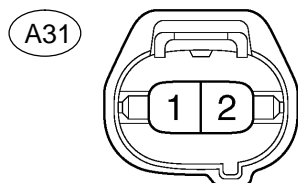
**NG**

**Repair or replace harness or connector and go to step 6.**

**OK**

# 14 Check for open in harness and connector between air switching valve and body ground.

## Wire Harness Side:



N

B17440

Air Switching Valve Connector

## PREPARATION:

- Remove the intake manifold (see page [EM-36](#)).
- Disconnect the A31 air switching valve connector.

## CHECK:

Measure the resistance between the wire harness side connectors and body ground.

## OK:

### Standard:

Tester Connection	Specified Condition
A31-2 – Body ground	Below 1 $\Omega$

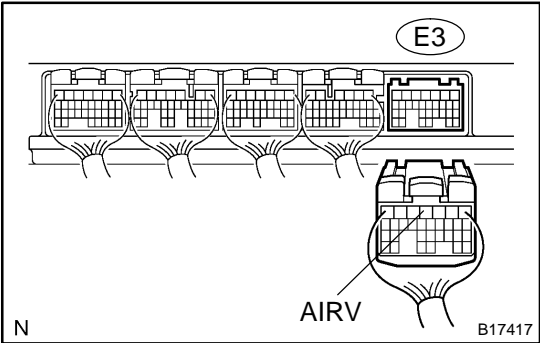
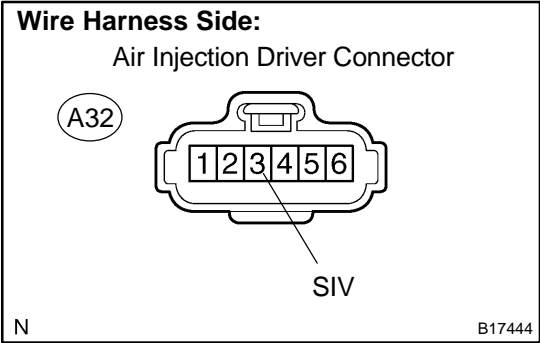
**NG**

**Repair or replace harness or connector and go to step 6.**

**OK**

15

Check for open and short in harness and connector between air injection driver and ECM.



**PREPARATION:**

- (a) Disconnect the air injection driver connector.
- (b) Disconnect the E3 ECM connector.

**CHECK:**

Measure the resistance between the wire harness side connectors.

**OK:**

**Standard:**

Tester Connection	Specified Condition
SIV (A32-3) – AIRV (E3-4)	Below 1 $\Omega$
SIV (A32-3) or AIRV (E3-4) – Body ground	10 k $\Omega$ or higher

NG

Repair or replace harness or connector and go to step 6.

OK

Replace ECM (See page [SF-82](#)).