|--|

DTC	P1444	SECONDARY AIR INJECTION SYSTEM SWITCHING VALVE NO.2 BANK 2 STUCK OPEN
-----	-------	---

DTC	P2440	SECONDARY AIR INJECTION SYSTEM SWITCHING VALVE STUCK OPEN BANK1
-----	-------	--

# **CIRCUIT DESCRIPTION**

Refer to DTC P0412 on page 05-609.

DTC No.	DTC Detection Condition	Trouble Area	
P1441	Air switching valve No.2 (Bank 1) stuck open: The pressure sensor detects exhaust pulsation, when both of air switching valve No.2 OFF (and air switching valve ON). (2 trip detection logic)	<ul> <li>VSV for air injection control circuit (Bank 1)</li> <li>Air switching valve No.2 (Bank 1)</li> <li>VSV for air injection system (Bank 1)</li> <li>ECM</li> </ul>	
P1444	<b>Air switching valve No.2 (Bank 2) stuck open:</b> The pressure sensor detects exhaust pulsation, when both of air switching valve No.2 OFF (and air switching valve ON). (2 trip detection logic)	<ul> <li>VSV for air injection control circuit (Bank 2)</li> <li>Air switching valve No.2 (Bank 2)</li> <li>VSV for air injection system (Bank 2)</li> <li>ECM</li> </ul>	
P2440	Air switching valve stuck open: The pressure sensor detects exhaust pulsation when the sys- tem is not operate (both of air switching valve No.2 OFF, and air switching valve OFF and air pump OFF). This DTC means open stuck of air switching valve and "air switching valve No.2 bank 1 or bank 2". (1 trip detection logic)	<ul> <li>Electromagnetic air switching valve</li> <li>Air switching valve No.2 (Bank 1 and/or 2)</li> <li>VSV for air injection system (Bank 1 and/or 2)</li> <li>Air injection driver</li> <li>Air injection driver circuit</li> <li>ECM</li> </ul>	

# **MONITOR DESCRIPTION**

The ECM detects pressure change with the pressure sensor to determine malfunctioning parts in the system, and stores the DTCs. The ECM measures pressure and/or exhaust pulsation of the system at 6 points, A to F, when the air injection system is in operation or when not in operation. When the pressure is high, the ECM determines that the pump operates. When exhaust pulsation is detected, the ECM determines that the ASV is open. The ECM determines malfunction parts based on the measured value, and stores the DTCs. Points A and B:

ECM detects pressure changes (decrease), and determines that the ASV No.2 is open. Points C and F:

ECM detects pressure and exhaust pulsation, and determines the pressure pattern of the system. Point D:

ECM operates the system, as indicated by the dashed lines, to determine which of the ASV No.2 is malfunctioning only when pressure changes cannot be detected at point A or B.

Point E:

ECM detects exhaust pulsation to determine the condition of the system.



## Pressure condition in Secondary Air Injection System (Point C and F) Pattern 1:

Air Pump	ON
Air Switching Valve and Air Switching Valve No.2	Open
Pressure	1 kPa or more
Pulsation detection	Exhaust gas pulsation detected

#### Pattern 2:

Air Pump	OFF
Air Switching Valve and Air Switching Valve No.2	Open
Pressure	Less than 5 kPa
Pulsation detection	Exhaust gas pulsation detected
Pattern 3:	

Air Pump	ON
Air Switching Valve and Air Switching Valve No.2	Close
Pressure	1 kPa or more
Pulsation detection	Slight pulsation detected

## Pattern 4:

Air Pump	OFF
Air Switching Valve and Air Switching Valve No.2	Close
Pressure	Less than 5 kPa
Pulsation detection	Not detected

# Judgement and decision of failure mode:

Monitor			Judgement			
С	F	А	В	D	E	DTCs where set
Pattern 1	Pattern 1	Pressure changed	Pressure changed	-	No pulsation detected	P2444, P1441 and P1444
Pattern 1	Pattern 1	No pressure changed	Pressure changed	-	No pulsation detected	P2444 and "P1441 or P1444"
Pattern 1	Pattern 1	Pressure changed	No pressure changed	Pulsation detected	No pulsation detected	P2444, P1441 and P1444
Pattern 1	Pattern 1	No pressure changed	No pressure changed	Pulsation detected	No pulsation detected	P2444, P1441 and P1444
Pattern 1	Pattern 2	Pressure changed	Pressure changed	-	No pulsation detected	P1441 and P1444
Pattern 1	Pattern 2	No pressure changed	Pressure changed	-	No pulsation detected	P1441 or P1444
Pattern 1	Pattern 2	Pressure changed	No pressure changed	Pulsation detected	No pulsation detected	P1441 and P1444
Pattern 1	Pattern 2	No pressure changed	No pressure changed	Pulsation detected	No pulsation detected	P1441 and P1444
Pattern 1	Pattern 3	Pressure changed	Pressure changed	-	No pulsation detected	P2444
Pattern 1	Pattern 3	No pressure changed	Pressure changed	-	No pulsation detected	P2444 and "P1442 or P1445"
Pattern 1	Pattern 3	Pressure changed	No pressure changed	No pulsation detected	No pulsation detected	P2444 and "P1442 or P1445"
Pattern 1	Pattern 3	No pressure changed	No pressure changed	No pulsation detected	No pulsation detected	P2444, P1442 and P1444
Pattern 1	Pattern 4	Pressure changed	Pressure changed	-	No pulsation detected	Normal
Pattern 1	Pattern 4	Pressure changed	No pressure changed	Pulsation detected	No pulsation detected	Normal
Pattern 1	Pattern 4	Pressure changed	No pressure changed	No pulsation detected	No pulsation detected	P1442 or P1445
Pattern 1	Pattern 4	No pressure changed	Pressure changed	-	No pulsation detected	P1442 or P1445
Pattern 1	Pattern 4	No pressure changed	No pressure changed	Pulsation detected	No pulsation detected	P1442 or P1445
Pattern 1	Pattern 4	No pressure changed	No pressure changed	No pulsation detected	No pulsation detected	P1442 and P1445
Pattern 2	-	No pressure changed	No pressure changed	-	-	P2445
Pattern 3	Pattern 3	No pressure changed	No pressure changed	No pulsation detected	No pulsation detected	P2441, P2444, P1442 and P1445
Pattern 3	Pattern 4	No pressure changed	No pressure changed	No pulsation detected	No pulsation detected	P2441, P1442 and P1445
Pattern 4	-	No pressure changed	No pressure changed	_	-	P2445
_	_	_	_	_	Pulsation detected	P2440 and "P1441 or P1444"

# **MONITOR STRATEGY**

Related DTCs	P1441: Air switching valve No.2 (Bank 1) is stuck open P1444: Air switching valve No.2 (Bank 2) is stuck open P2440: Air switching valve and air switching valve No. 2 are stuck open
Required sensors/components	Pressure sensor, Air switching valve No.2 (Bank 1, 2), Electromagnetic air switch- ing valve
Frequency of operation	Continuous
Duration	P1441 (Air switching valve No.2 (Bank 1) is stuck open): 20 sec. P1444 (Air switching valve No.2 (Bank 2) is stuck open): 20 sec. P2440 (Air switching valve and air switching valve No.2 are stuck open): 18 sec.
MIL operation	P1441 (Air switching valve No.2 (Bank 1) is stuck open): 2 driving cycles P1444 (Air switching valve No.2 (Bank 2) is stuck open): 2 driving cycles P2440 (Air switching valve and air switching valve No.2 are stuck open): 1 driving cycle
Sequence operation	None

# **TYPICAL ENABLING CONDITION**

#### P1441, P1444: Air switching valve No.2 (Bank 1 and/or Bank 2) are stuck open

The monitor will run whenever these DTCs are not present See page 05-413

Case 1:	
Atmospheric pressure	76 kPa (570 mmHg) or more
Battery voltage	11.5 V or more
Time after secondary air injection out of operation	10 sec. or more
Air pump	OFF
Time after engine start	10 sec. or more
Air switching valve No. 2 (Bank 1)	OFF
Air switching valve No. 2 (Bank 2)	OFF
Air injection pressure sensor fail	Not detected
Air switching valve	ON
Engine RPM	Less than 3,750 rpm

## Case 2:

Atmospheric pressure	76 kPa (570 mmHg) or more
Battery voltage	11.5 V or more
Air pump	OFF
Time after engine start	10 sec. or more
Air switching valve No. 2 (Bank 1)	OFF
Air switching valve No. 2 (Bank 2)	OFF
Air injection pressure sensor fail	Not detected
Engine load	0% or more
Intake air amount	40 g/sec or more
IAT at engine start	–15°C (5°F) or more
ECT at engine start	Less than 5°C (41°F)
Air switching valve	ON
Engine RPM	Less than 3,750 rpm

### P2440: Electromagnetic air switching valve No.2 is stuck open

The monitor will run whenever these DTCs are not present	See page 05-413
Atmospheric pressure	76 kPa (570 mmHg) or more
Battery voltage	11.5 V or more
Time after secondary air injection out of operation	10 sec. or more
Cumulative intake air amount	172 g or more
Air pump	OFF
Air switching valve	OFF

2005 4RUNNER REPAIR MANUAL (RM1165U)

Air switching valve No.2 (Bank 1)	OFF
Air switching valve No.2 (Bank 2)	OFF
Engine RPM	Less than 3,750 rpm
Air injection pressure sensor fail	Not detected

# **TYPICAL MALFUNCTION THRESHOLDS**

# P1441, P1444: Air switching valve No.2 (Bank 1 and/or Bank 2) are stuck open Case 1:

Both of the following conditions are met:	Conditions 1 and 2
1. Cumulative pressure pulsation (When AI OFF)	20 kPa (150 mmHg) or more
2. Air pressure change (When ASV No.2 open) (P1441 (Bank 1), P1444 (Bank 2))	Less than 1 kPa (7.5 mmHg) or more

#### Case 2:

Detected times of identifying condition 1 is met	4 times or more
1. Cumulative pressure pulsation	100 kPa (750 mmHg) or more

#### P2440: Electromagnetic air switching valve No.2 are stuck open

Detected times of identifying condition 1 is met	4 times or more
1. Cumulative pressure pulsation	100 kPa (750 mmHg) or more

# **MONITOR RESULT**

Refer to page 05-421 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	\$E9	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	\$E5	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 P0412 on page 05-609.

# **INSPECTION PROCEDURE**

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

- (a) Connect hand-held tester to the DLC3.
- (b) Turn the ignition switch to ON and turn the tester ON.
- (c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (d) Read DTCs.
  - **Result:**

Display (DTC Output)	Proceed To
"P1441 and/or P1444" and P2440	A
P1441 and/or P1444	В
"P1441 and/or P1444 and/or P2440" and other DTCs	C

HINT:

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



Α

2

## CHECK AIR SWITCHING VALVE(OPERATION)



- (a) Remove the intake manifold.
- (b) Remove the air switching valve.
- (c) Blow air into port A and check that air is not discharged from port B. OK:

# Not discharged



- (d) Apply battery positive across the terminals.
- (e) Blow air into port A and check that air is discharged from port B.

**REPLACE AIR SWITCHING VALVE** 

OK:

NG

Discharged

OK

# 3 CHECK AIR SWITCHING VALVE(VOLTAGE)



ΟΚ

#### CHECK FOR INTERMITTENT PROBLEMS (See page 05-406)

# 4 CHECK HARNESS AND CONNECTOR(AIR INJECTION DRIVER – AIR SWITCHING VALVE)





REPLACE ECM (See page 10-27)

## 7 CHECK AIR SWITCHING VALVE NO.2(OPERATION)

- (a) Start the engine and warm it up.
- (b) Turn the ignition switch to OFF.
- (c) Connect the hand-held tester to the DLC3.
- (d) Start the engine and push the hand-held tester main switch ON.
- (e) Select the following menu items: DIAGNOSIS/EN-HANCED OBD II/SYSTEM CHECK/ AIR INJ CHECK/ MANUAL OPERATION/OPERATION 5 and 6

G32730 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 Al 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..

- When performing the AIR INJ 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 to OFF when the AIR INJ CHECK operation finishes.
- (f) Read values of the A/F BANK1 and BANK2 on the handheld 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 value is open, and approximately 14.5 when the value is closed.
- Perform the following procedures only on the bank of which the valve is not closed.

NEXT

8

## CHECK VSV(AIR INJECTION CONTROL)



- (a) Turn the ignition switch OFF.
- (b) Disconnect the vacuum hose from the VSV for air injection control.
- (c) Connect the hand-held tester to the DLC3.
- (d) Start the engine and turn the tester ON.
- (e) Select the following menu items: DIAGNOSIS/EN-HANCED OBD II/SYSTEM CHECK/ AIR INJ CHECK/ MANUAL OPERATION/OPERATION 1
- (f) At this time, check that no negative pressure generates at port A of the VSV.

HINT:

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

## NOTICE:

 This test only allows technicians to operate the Al 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..

- When performing the AIR INJ 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 to OFF when the AIR INJ CHECK operation finishes.
   OK:

No negative pressure is generated.

(g) Reconnect the vacuum hose.

NG > Go to step 10

ΟΚ

#### 05-693



# 10 CHECK VSV(AIR INJECTION CONTROL)



(a) Disconnect the VSV for air injection control connector.
(b) Check that air does not flow from the port as shown in the illustration.
OK:

Does not flow from port A



(c) Apply battery positive across the terminals, check that air flows from the ports.
 OK:

Flows from port A

NG > REPLACE VSV

ОК

#### 11 **CHECK HARNESS AND CONNECTOR(ECM - VSV FOR AIR INJECITON** CONTROL)





- Remove the intake manifold.
- Disconnect the E5 ECM connector.
- Disconnect the V10 and V11 VSV for air injection control
- Measure the resistance between the VSV connector and

Tester connection	Specified condition
AIV1 (E5–27) – VSV (V10–2)	Below 1 Ω
AIV2 (E5–26) – VSV (V11–2)	Below 1 Ω

Measure the resistance between the VSV connectors and body ground.

#### Standard:

CONNECTOR

Tester connection	Specified condition			
AIV1 (E5–27) or VSV (V10–2) –				
Body ground	TO KS2 of higher			
AIV2 (E5–26) or VSV (V11–2) –	10 KO ar histor			
Body ground	10 K12 or higher			
(f) Reconnect the ECM connector.				
(g) Reconnect the VSV connectors.				
	EPLACE HARNESS OR			

ΟΚ

REPLACE ECM (See page 10-27)