DTC	P2444	Secondary Air Injection System Pump Stuck On Bank1

DTC	P2445	Secondary Air Injection System Pump Stuck Off Bank1

DESCRIPTION

Refer to P2440 (See page ES-354).

DTC No.	DTC Detection Conditions	Trouble Areas
P2444	Secondary air pressure more than 2.5 kPa (19 mmHg) despite ECM commanding air pump to turn off (2 trip detection logic)	• Short in air pump circuit • Open or short in pressure sensor circuit • Pressure sensor • Air Injection Control Driver (AID) • ECM
P2445	Secondary air pressure less than 2.5 kPa (19 mmHg) despite ECM commanding air pump to turn on (2 trip detection logic)	• Air pump • Open in air pump circuit • Air injection system piping • Vacuum hose (pressure sensor - air switching valve) • Pressure sensor • Open or short in pressure sensor circuit • Air Injection Control Driver (AID) • ECM

ES

MONITOR DESCRIPTION

The ECM monitors the pressure in the secondary air passage using the pressure sensor located on the Air Switching Valve (ASV) of the Secondary Air Injection (AIR) system. The sensor measures the pressure in the secondary air passage and transmits a signal to the ECM.
If either of the following conditions occurs, the ECM interprets it as a malfunction of the AIR system, and illuminates the MIL and sets a DTC:

- The pressure indicated by the pressure sensor does not reach threshold levels despite the ECM turning on the air pump.
- The pressure indicated by the pressure sensor exceeds threshold levels despite the ECM turning off the air pump.

MONITOR STRATEGY

Related DTCs	P2444: Air pump stuck ON P2445: Air pump stuck OFF
Required Sensors/Components (Main)	Pressure sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per drive cycle
Duration	7 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	• P0010 - P0022: VVT system • P0031 - P0052: Front A/F sensor heater • P0100 - P0103: MAF sensor • P0110 - P0113: IAT sensor • P0115 - P0118: ECT sensor • P0120 - P2125: TP sensor • P0125: Closed loop • P0171 - P0175: Fuel trim • P0300 - P0308: Misfire • P0325 - P0333: Knock sensor • P0335: CKP sensor • P0340 - P0346: VVT sensor • P0351 - P0358: Igniter • P0441 - P2420: EVAP system • P0500: VSS • P1340: CMP sensor • P2195 - P2A03: A/F sensor • P2430 - P2433: AIR pressure sensor
Battery voltage	11 V or more
Atmospheric pressure	45 kPa (337.5 mmHg) or more

While secondary air injection ON:

Secondary air injection pump	ON
Secondary air injection switching valve	ON
Engine speed	Less than 3,750 rpm
Delay time after engine started	6 seconds or more
Pressure sensor malfunction	Not detected

While secondary air injection OFF:

Secondary air injection pump	OFF
Engine speed	Less than 3,750 rpm
Secondary air injection system monitor during secondary air injection ON	Completed
Pressure sensor malfunction	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Condition 1:

AIR pressure during AIR ON	2.5 kPa or more and pulse is generated

Condition 2:

AIR pressure during AIR ON	Less than 2.5 kPa and pulse is generated

Condition 3:

AIR pressure during AIR ON	2.5 kPa or more and pulse is not generated

Condition 4:

AIR pressure during AIR ON	Less than 2.5 kPa and pulse is not generated

Condition 5:

AIR pressure during AIR OFF	2.5 kPa or more and pulse is generated

Condition 6:

AIR pressure during AIR OFF	Less than 2.5 kPa and pulse is generated

Condition 7:

AIR pressure during AIR OFF	2.5 kPa or more and pulse is not generated

Condition 8:

AIR pressure during AIR OFF	Less than 2.5 kPa and pulse is not generated

P2444: AIR pump stuck ON

Both of following conditions met:	(a) and (b)
(a) Not condition 6	Met
(b) Not condition 8	Met

P2445: AIR pump stuck OFF

Both of following conditions met:	(a) and (b)
(a) Not condition 1	Met
(b) Not condition 3	Met

P2445: AIR insufficient

AIR amount	0 L/min or less

ES

MONITOR RESULT

Refer to Checking Monitor Status (See page ES-21).

WIRING DIAGRAM

Refer to DTC P2440 (See page ES-356).

HINT:
Determination by ECM monitoring:
The ECM locates malfunctions in the secondary Air Injection (AIR) system by detecting the pressure in the AIR passage between the air pump and Air Switching Valve (ASV) and sets a DTC. Soon after cold engine starts, the monitor runs for a short time while the AIR system is both ON and OFF. The ECM detects both the pressure and the exhaust pulsation and compares them.
The following 4 patterns are AIR system pressure conditions in the AIR system passage.

Pressure condition in Secondary Air Injection System Case 1:

Air Pump	ON
Air Switching Valve	Open
Pressure	2.5 kPa or more
Pulsation Detection	Exhaust gas pulsation detected

Pressure condition in Secondary Air Injection System Case 2:

Air Pump	OFF
Air Switching Valve	Open
Pressure	Less than 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	2.5 kPa or more
Pulsation Detection	Slight pulsation detected

Pressure condition in Secondary Air Injection System Case 4:

Air Pump	OFF
Air Switching Valve	Closed
Pressure	Less than 2.5 kPa
Pulsation Detection	Exhaust pulsation not detected

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

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

HINT:

- In case 3, as the pressure sensor detects a slight pump operation pulsation, the detected value is not constant. Since the pump outlet is blocked by closing the ASV, the average pressure is higher than in case 1 (approximately 20 to 30 kPa).
- In case 1, the average pressure is approximately 9 to 11 kPa. The value of 2.5 kPa indicated in the table above is a threshold for detecting pump malfunctions.

Detected Conditions while AIR operating: Air pump ON, ASV Open	Detected Conditions while AIR not operating: Air pump OFF, ASV Closed	ECM Determination	DTCs Output
Case 1	Case 4	Normal	-
Case 1	Case 2	ASV stuck open	P2440
Case 1	Case 3	Air pump stuck ON	P2444
Case 2	Case 4	Air pump stuck OFF	P2445
Case 3	Case 4	ASV stuck closed	P2441
Case 1	Case 1	ASV stuck open and Air pump stuck ON	P2440 and P2444
Case 2	Case 2	ASV stuck open and Air pump stuck OFF	P2440 and P2445
Case 3	Case 3	ASV stuck closed and Air pump stuck ON	P2441 and P2444
Case 4	Case 4	ASV stuck closed and Air pump stuck OFF	P2441 and P2445

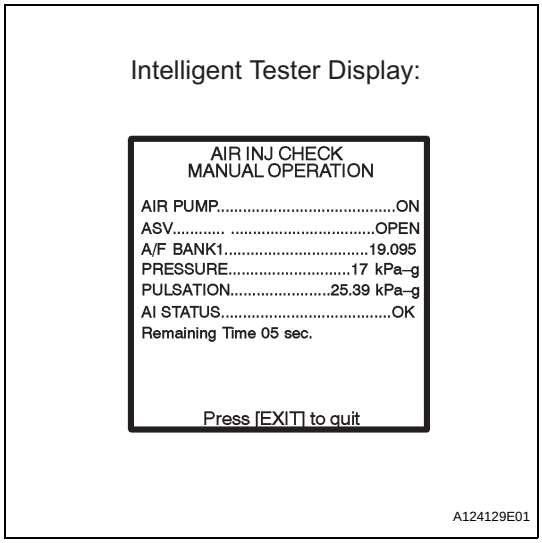
HINT:

- If the vacuum hose between the ASV and the pressure sensor is not connected correctly, case 4 may occur.
- By using an intelligent tester to perform the AIR INJ 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 SYSTEM CHECK / AUTOMATIC OPERATION after the repair.
- Read freeze frame data using an intelligent tester. Freeze frame data record 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 an intelligent tester.

(a) Start the engine and warm it up.



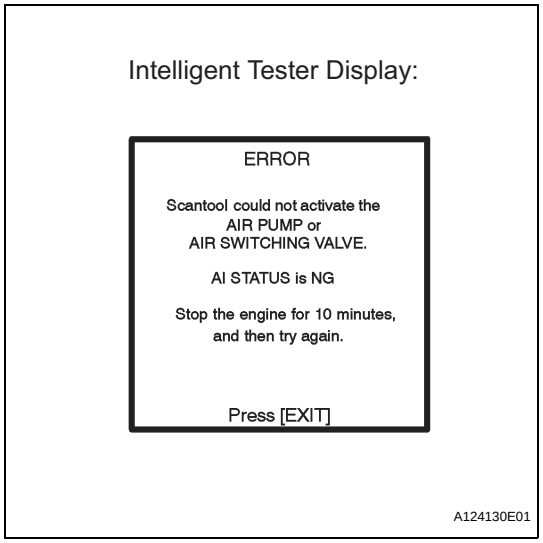
(b) Turn the ignition switch to OFF.
(c) Connect an intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation canbe selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Check that the air pump (AIR PUMP), ASV and pressure in the AIR system passage (PRESSURE) displayed on the tester, indicate the conditions shown in the table below.

Standard

Intelligent Tester Operations	AIR PUMP	ASV	PRESSURE *1	PULSATION *2
AP: ON, ASV: OPEN	ON	OPEN	2.5 kPa or more	11.25 kPa or more
AP: OFF, ASV: CLOSE	OFF	CLOSE	Less than 2.5 kPa	Less than 11.25 kPa

*1:
Average pumping pressure (gauge pressure). The pressure should be 2.5 kPa or more when the AIR system operates.
*2:
The cumulative exhaust pulsation calculated by the ECM. If the calculated value exceeds a certain level, the ECM determines that the exhaust pulsation is in the AIR system.

(i) Turn the ignition switch to OFF.



NOTICE:

- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds.**
  Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.
  While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**
- **When performing the AIR 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.**

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2444 AND/OR P2445)

(a) Connect an intelligent 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
P2444 and/or P2445	A
P2444 and/or P2445, and P0418	B
P2444 and/or P2445, and other DTCs (except P0418)	C

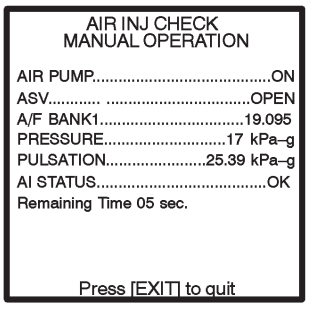
If any DTCs other than P2444, P2445 and/or P0418 are output, troubleshoot those DTCs first.

B	GO TO AIR PUMP INSPECTION PROCEDURE
C	GO TO DTC CHART

A

2	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (SECONDARY AIR INJECTION SYSTEM OPERATION)

Intelligent Tester Display:



A124129E01

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV CLOSE.
HINT:
When MANUAL OPERATION is selected, the tester initialization (atmospheric pressure measurement) is performed automatically. The initialization takes 10 seconds. After the initialization, AP and ASV operation can be selected.
(f) Start the engine.
(g) Perform the AIR system intrusive operation while the engine is idling.
(h) Check that the air pump (AIR PUMP), ASV and pressure in the AIR system passage (PRESSURE) status displayed on the tester, indicate the conditions shown in the table below.

Standard

Intelligent Tester Operations	AIR PUMP	ASV	PRESSURE*
AP: ON, ASV: OPEN	ON	ON	2.5 kPa or more
AP: OFF, ASV: CLOSE	OFF	OFF	Less than 2.5 kPa

*: Average pumping pressure. The pressure should be 2.5 kPa or more when the AIR system operates.

Intelligent Tester Display:

A124130E01

(i) Turn the ignition switch to OFF.

NOTICE:

- **This AIR INJECTION CHECK only allows technicians to operate the AIR system for a maximum of 5 seconds.**
  Furthermore, the check can only be performed up to 4 times per trip. If the test is repeated, intervals of at least 30 seconds are required between checks.
  While AIR system operation using the intelligent tester is prohibited, the tester display indicates the prohibition (WAIT or ERROR).
  If an ERROR as shown in the illustration is displayed on the tester during the test, stop the engine for 10 minutes, and then try again.
- **Performing the AIR INJ CHECK repetitively may cause damage to the AIR system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations to prevent the system from overheating.**

- **When performing the AIR 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.**

NG → **Go to step 4**

OK

3 CHECK WHETHER DTC OUTPUT RECURS (DTC P2444 AND/OR P2445)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.
(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

NOTICE:

- **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.**

Result

Display (DTC output)	Proceed To
P2444 and/or P2445	A
No pending DTC	B

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

4 CHECK VACUUM HOSES (PRESSURE SENSOR - AIR SWITCHING VALVE)

(a) Check the vacuum hose connections with the pressure sensor and ASV.
(b) Inspect the vacuum hose for blockages and damage.

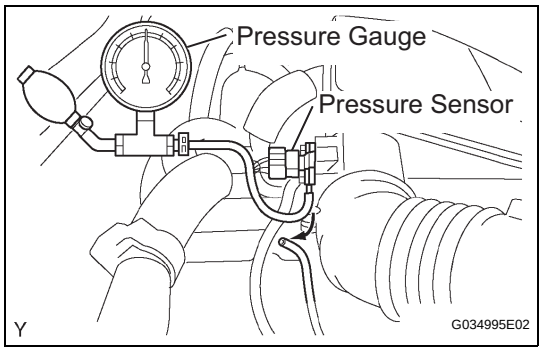
OK:

Vacuum hose has no blockages or damage.

NG → **REPAIR OR REPLACE VACUUM HOSE**

OK

5	INSPECT ECM (AIP VOLTAGE)

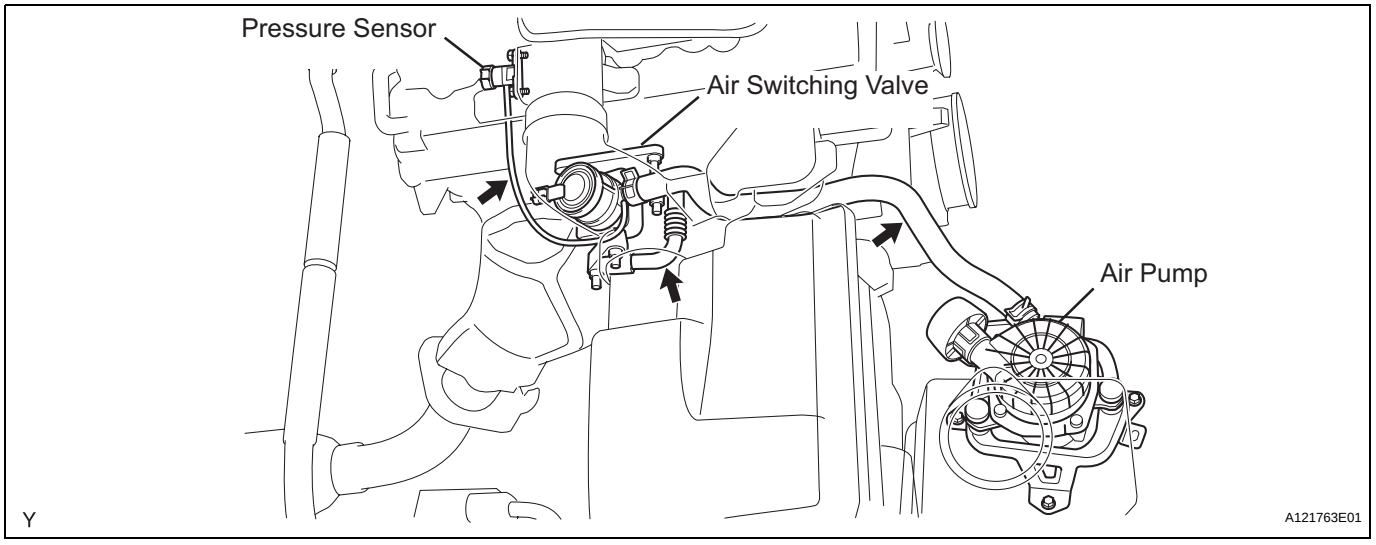


(a) Connect a pressure gauge to the air pressure sensor as shown in the illustration.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to ON and the tester ON.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD ll / DATA LIST / AIR PMP PRS(A).
(e) Check that the pressure displayed on the tester fluctuates when applying the pressure to the pressure sensor with the pressure gauge.
OK:
Pressure fluctuates in response to pressure applied with pressure gauge.
HINT:
The tester displays the air pump pressure (AIR PMP PRS(A)) as absolute pressure.

NG → **REPLACE PRESSURE SENSOR (TURBO PRESSURE SENSOR)**

OK

6	CHECK AIR INJECTION SYSTEM PIPE CONNECTIONS

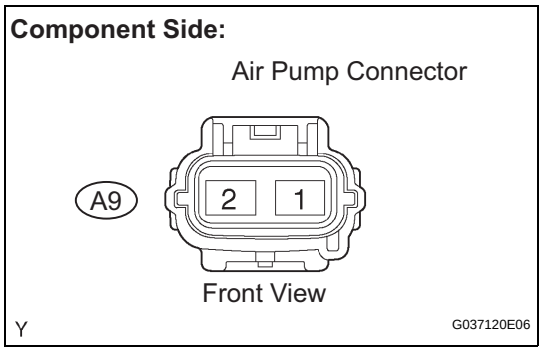


(a) Check that all the pipes and hoses between the air pump and ASV are securely connected.
(b) Inspect the pipes and hoses for blockages and damage.
OK:
AIR system piping has no blockages or damage.

NG → **REPAIR OR REPLACE AIR INJECTION SYSTEM PIPING**

OK

7 INSPECT AIR PUMP ASSEMBLY



(a) Check the resistance.
(1) Using an ohmmeter, measure the resistance between the terminals.
Standard Resistance

Tester Connections	Specified Conditions
Air pump (A9-1) - Air pump (A9-2)	0.4 to 10 Ω at 20°C (68°F)

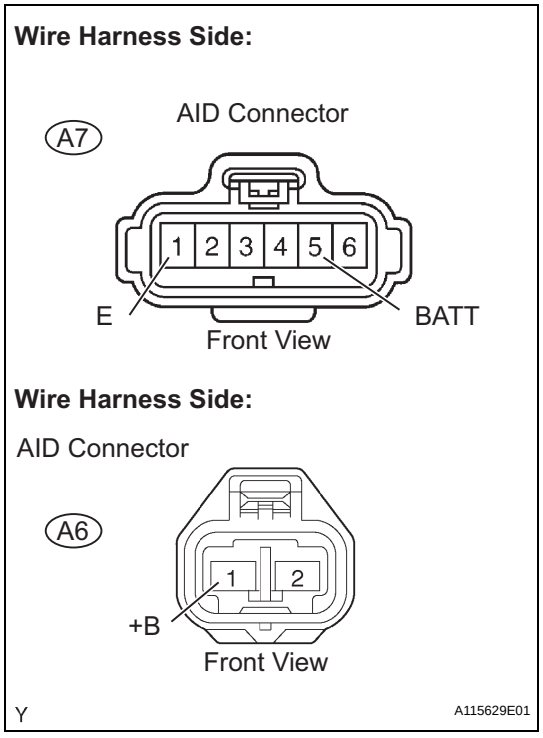
If the result is not as specified, replace the air pump.
HINT:
To check the air pump operation, use the AIR INJ CHECK function described in the SYSTEM CHECK.

ES

NG → **REPLACE AIR PUMP ASSEMBLY**

OK

8 INSPECT AIR INJECTION CONTROL DRIVER (AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT)



(a) Disconnect the A6 and A7 AID connectors.
(b) Turn the ignition switch to ON.
(c) Measure the voltage between the terminals of the AID connector.
Standard Voltage

Tester Connections	Specified Conditions
BATT (A7-5) - Body ground	9 to 14 V (near battery voltage)
+B (A6-1) - Body ground	9 to 14 V (near battery voltage)

(d) Check the resistance.
Standard Resistance (Check for open)

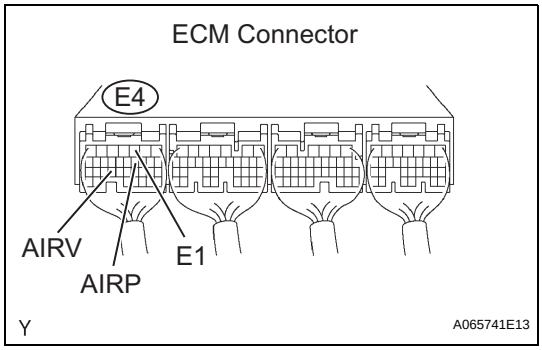
Tester Connections	Specified Conditions
E (A7-1) - Body ground	Below 1 Ω

(e) Reconnect the AID connector.

NG → **REPAIR OR REPLACE AIR INJECTION CONTROL DRIVER POWER SOURCE CIRCUIT**

OK

9	PERFORM ACTIVE TEST USING INTELLIGENT TESTER



(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / MANUAL OPERATION / AP: ON, ASV: OPEN and AP: OFF, ASV: CLOSE.
(f) Start the engine after the tester initialization is finished.
(g) Operate the AIR system using SYSTEM CHECK function and measure the voltage between the terminals of the ECM connector.
(h) Turn the ignition switch to OFF.

NOTICE:

- **Do not perform the SYSTEM CHECK operation repetitively. It may cause damage to the system. If necessary, leave an interval of several minutes between SYSTEM CHECK operations.**
- **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.**

Standard Voltage

Intelligent Tester Operations	Voltmeter Connections	Specified Conditions
AP: ON, ASV: OPEN	AIRP (E4-11) - E1 (E4-3)	3.5 to 7.5 V
AP: OFF, ASV: CLOSE	AIRP (E4-11) - E1 (E4-3)	10 V or more
AP: ON, ASV: OPEN	AIRV (E4-24) - E1 (E4-3)	3.5 to 7.5 V
AP: OFF, ASV: CLOSE	AIRV (E4-24) - E1 (E4-3)	10 V or more

NG → Go to step 12

OK

10	REPLACE AIR INJECTION CONTROL DRIVER

NEXT

11	CHECK WHETHER DTC OUTPUT RECURS (DTC P2444 AND/OR P2445)

(a) Start the engine and warm it up.
(b) Turn the ignition switch to OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to ON and turn the tester ON.
(e) Clear DTCs (where set) (see page ES-40).
(f) Select the following menu items:

DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / AIR INJ CHECK / AUTOMATIC OPERATION.

(g) Start the engine after the tester initialization is finished.
(h) Perform the SYSTEM CHECK operation by pressing ENTER.
(i) After operating the AIR system, press the ENTER button to confirm the AIR system pending codes.
(j) Check PENDING DTCs.
(k) Turn the ignition switch to OFF.

OK:

No pending DTC output.

NOTICE:

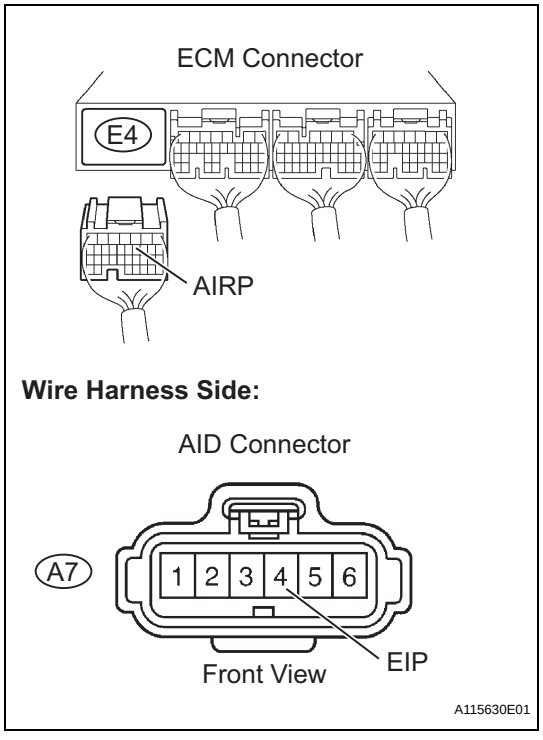
- **When performing the AIR INJ CHECK operation after the battery cable has been reconnected, wait for 7 minutes with the ignition switch turned to ON or the engine running.**
- **Turn the ignition switch to OFF when the AIR INJ CHECK operation finishes.**

ES

NEXT

END

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



(a) Disconnect the E4 ECM connector.
(b) Disconnect the A7 AID connector.
(c) Check the resistance.

Standard Resistance (Check for open)

Tester Connections	Specified Conditions
AIRP (E4-11) - EIP (A7-4)	Below 1 Ω

(d) Reconnect the ECM and AID connectors.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM