DIDRF−01

DTC	P0171	System too Lean (Bank 1)

DTC	P0172	System too Rich (Bank 1)

DTC	P0174	System too Lean (Bank 2)

DTC	P0175	System too Rich (Bank 2)

CIRCUIT DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short−term and long−term fuel trims.

The short−term fuel trim is fuel compensation that is used to constantly maintain the air−fuel ratio at stoichiometric levels. The signal from the Air−Fuel Ratio (A/F) sensor indicates whether the air−fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air−fuel ratio is rich and an increase in the fuel injection volume if it is lean.

Factors such as individual engine differences, wear over time and changes in operating environment cause short−term fuel trim to vary from the central value. The long−term fuel trim, which controls overall fuel compensation, compensates for long−term deviations in the fuel trim from the central value caused by the short−term fuel trim compensation.

If both the short−term and long−term fuel trims are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

DTC No.	DTC Detecting Condition	Trouble Area
P0171 P0174	When air−fuel ratio feedback is stable after warming up the engine, fuel trim is considered to be in error on LEAN side (2 trip detection logic)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leakage in exhaust system • Open or short in heated oxygen sensor (bank 1, 2 sensor 1) circuit • Heated oxygen sensor (bank 1, 2 sensor 1) • Heated oxygen sensor heater (bank 1, 2 sensor 1) • EFI relay • PCV piping • ECM
P0172 P0175	When air−fuel ratio feedback is stable after warming up the engine, fuel trim is considered to be in error on RICH side (2 trip detection logic)	• Injector leak, blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in heated oxygen sensor (bank 1, 2 sensor 1) circuit • Heated oxygen sensor (bank 1, 2 sensor 1) • ECM

HINT:

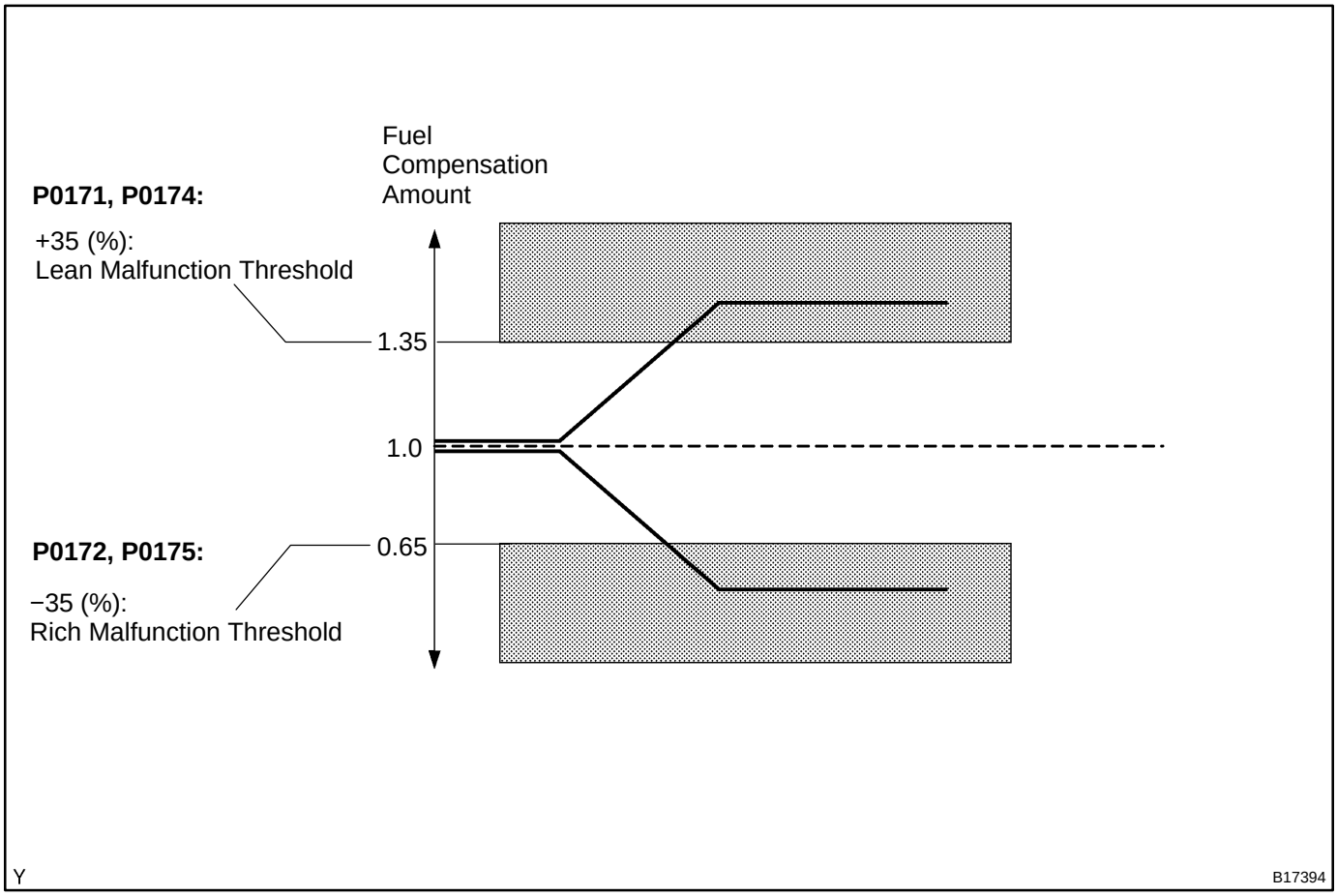
- When DTC P0171 or P0174 is recorded, the actual air−fuel ratio is on the LEAN side. When DTC P0172 or P0175 is recorded, the actual air−fuel ratio is on the RICH side.
- If the vehicle runs out of fuel, the air−fuel ratio is LEAN and DTC P0171 or P0174 may be recorded. The MIL then comes on.
- If the total of the short−term fuel trim value and long−term fuel trim value is within ± 35 % (engine coolant temperature is more than 75 °C (167°F)), the system is functioning normally.

MONITOR DESCRIPTION

Under closed−loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long−term fuel trim compensation value. The long−term fuel trim is adjusted when there are persistent deviations in the short−term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learning value, which is a combination of the average short−term fuel trim (fuel feedback compensation value) and the average long−term fuel trim (learning value of the air−fuel ratio). If the average fuel trim learning value exceeds the malfunction thresholds, the ECM interprets this a fault in the fuel system and sets a DTC.

Example:

The average fuel trim leaning value is more than +35 % or less than −35 %, the ECM interprets this as a fuel system malfunction.



MONITOR STRATEGY

Related DTCs	P0171	Fuel system lean (Bank 1)
	P0172	Fuel system rich (Bank 1)
	P0174	Fuel system lean (Bank 2)
	P0175	Fuel system rich (Bank 2)
Required sensors/components	Main sensors/components	Front oxygen sensor
	Related sensors/components	Engine coolant temperature sensor, Mass air flow meter, Crankshaft position sensor
Frequency of operation	Continuous	
Duration	Within 10 seconds	
MIL operation	2 driving cycles	
Sequence of operation	None	

TYPICAL ENABLING CONDITIONS

Item	Specification	
	Minimum	Maximum
The monitor will run whenever this DTC is not present	See page DI−437	
Battery voltage	11 V	−
Fuel system status	Closed−loop	
Either of the following conditions is met:	Condition 1 or 2	
1. Engine RPM	−	1,000 rpm
2. Intake air amount per revolution	0.26 g/sec.	−
Catalyst monitor	No executed	

TYPICAL MALFUNCTION THRESHOLDS

Detection Criteria	Threshold
EVAP purge−cut	Executing
Either of the following conditions is met	Condition 1 or 2
1. Average between short−term fuel trim and long−term fuel trim	35% or more (varies with ECT)
2. Average between short−term fuel trim and long−term fuel trim	−35% or less (varies with ECT)

WIRING DIAGRAM

Refer to DTC P0031 on page DI−507.

INSPECTION PROCEDURE

HINT:

Hand−held tester only:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air−Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the A/F CONTROL operation using a hand−held tester.

(1) Connect a hand−held tester to the DLC3.
(2) Start the engine and turn the tester ON.
(3) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(4) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(5) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
(6) Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 (AFS B2S1) and OS2 B1S2 (OS2 B2S2)) displayed on the tester.

HINT:

- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard:

Tester Display (Sensor)	Injection Volumes	Status	Voltages
AFS B1S1 (AFS B2S1) (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 (AFS B2S1) (A/F)	−12.5 %	Lean	More than 3.35
O2S B1S2 (O2S B2S2) (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 (O2S B2S2) (HO2)	−12.5 %	Lean	Less than 0.4

NOTICE:

The Air−Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2, and press the YES button and then the ENTER button followed by the F4 button.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Areas
1	Injection volume +25 % −12.5 % Output voltage More than 3.35 V Less than 3.0 V **OK**	Injection volume +25 % −12.5 % Output voltage More than 0.55 V Less than 0.4V **OK**	—
2	Injection volume +25 % −12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % −12.5 % Output voltage More than 0.55 V Less than 0.4V **OK**	● A/F sensor ● A/F sensor heater ● A/F sensor circuit
3	Injection volume +25 % −12.5 % Output voltage More than 3.35 V Less than 3.0V **OK**	Injection volume +25 % −12.5 % Output voltage Almost no reaction **NG**	● HO2 sensor ● HO2 sensor heater ● HO2 sensor circuit
4	Injection volume +25 % −12.5 % Output voltage Almost no reaction **NG**	Injection volume +25 % −12.5 % Output voltage Almost no reaction **NG**	● Injector ● Fuel pressure ● Gas leakage from exhaust system (Air−fuel ratio extremely lean or rich)

HINT:

- Read freeze frame data using a hand−held 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.
- A low A/F sensor voltage could be caused by a rich air−fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air−fuel mixture. Check for conditions that would cause the engine to run lean.

1	**Check any other DTCs output (in addition to DTC P0171, P0172, P0174 or P0175).**

PREPARATION:

(a) Connect a 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.

CHECK:

(a) Read DTCs.

Result:

Display (DTC Output)	Proceed To
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B → **Go to relevant DTC chart (See page DI−477).**

A

2	**Check connection of PCV piping.**

OK:

PCV hose is connected correctly and is not damaged.

NG → **Repair or replace PCV piping.**

OK

3	**Check air induction system (See page SF−1).**

CHECK:

Check the air induction system for vacuum leaks.

NG → **Repair or replace air induction system.**

OK

4	**Perform active test (A/F control).**

(a) Connect the hand−held tester to the DLC3.
(b) Start the engine and turn the tester ON.
(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(e) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the voltage outputs of A/F and HO2 sensors(AFS B1S1 (AFS B2S1) and O2S B1S2 (O2S B2S2)) displayed on the tester.

HINT:

- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard:

Tester Display (Sensor)	Injection Volumes	Status	Voltages
AFS B1S1 (AFS B2S1) (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 (AFS B2S1) (A/F)	−12.5 %	Lean	More than 3.35
O2S B1S2 (O2S B2S2) (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 (O2S B2S2) (HO2)	−12.5 %	Lean	Less than 0.4

Result:

Status AFS B1S1 (AFS B2S1)	Status O2S B1S2 (O2S B2S2)	A/F Condition and A/F Sensor Condition	Misfires	Suspected Trouble Areas	Proceed To
Lean/Rich	Lean/Rich	Normal	—	—	C
Lean	Lean	Actual air−fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A

Rich	Rich	Actual air−fuel ratio rich	—	• Injector leakage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	A
Lean	Lean/Rich	A/F sensor malfunction	—	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	—	• A/F sensor	B

Lean: During A/F CONTROL, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.

B → **Go to step 11.**

C → **Go to step 15.**

A

5 **Read value of engine coolant temperature.**

PREPARATION:
(a) Connect the 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 / DATA LIST / ALL / COOLANT TEMP.

CHECK:
(a) Read the COOLANT TEMP twice, when the engine is cold and also when warmed up.
Standard:
With cold engine: Same as ambient air temperature.
With warm engine: Between 75°C and 95°C (167°F and 203°F)

NG → **Replace engine coolant temperature sensor.**

OK

6	**Read value of mass air flow meter.**

PREPARATION:

(a) Connect the 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 / DATA LIST / ALL / MAF and COOLANT TEMP.
(d) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.

CHECK:

(a) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.
Standard:
MAF while engine idling: Between 1.4 gm/s and 2.3 gm/s (shift position: N, A/C: OFF).
MAF at engine speed of 2,500 rpm: Between 5.4 gm/s and 7.9 gm/s (shift position: N, A/C: OFF).

NG → **Replace mass air flow meter.**

OK

7	**Check fuel pressure (See page SF−7).**

CHECK:

Check the fuel pressure (high or low pressure).

NG → **Check and replace fuel pump, pressure regulator, fuel pipe line and filter (See page SF−1).**

OK

8	**Check exhaust system for gas leakage.**

OK:

No exhaust gas leakage.

NG → **Repair or replace exhaust gas leakage point.**

OK

9	**Check for spark and ignition (See page IG−1).**

HINT:
If the spark plugs or ignition system malfunction, engine misfire may occur. The misfire counter can be read with the hand−held tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL#1 (to CYL#8).

NG → **Repair or replace ignition system.**

OK

10	**Check injector injection (See page SF−29).**

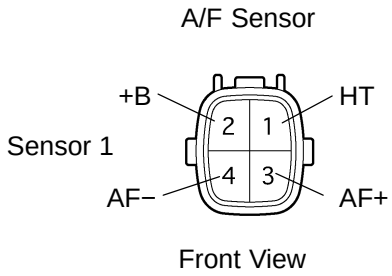
HINT:
If the injectors malfunction, engine misfires may occur. The misfire counter can be read with the hand−held tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL#1 (to CYL#8).

NG → **Replace injector.**

OK

11	**Check resistance of air−fuel ratio (A/F) sensor heater.**

Component Side:



PREPARATION:
Disconnect the air−fuel ratio (A/F) sensor connector.
CHECK:
Measure resistance between the terminals of the A/F sensor connector.
OK:

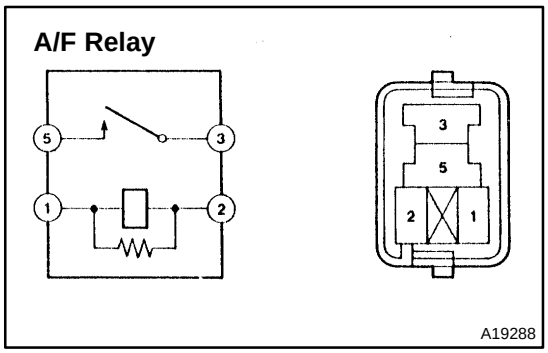
Standard:

Tester Connection	Specified Condition
HT (1) − +B (2)	1.8 to 3.4 Ω at 20°C (68°F)
HT (1) − AF− (4)	10 kΩ or higher

NG → **Replace air−fuel ratio (A/F) sensor.**

OK

12	Check A/F relay.



PREPARATION:

Remove the A/F relay from the engine room J/B.

CHECK:

Inspect the A/F relay.

OK:

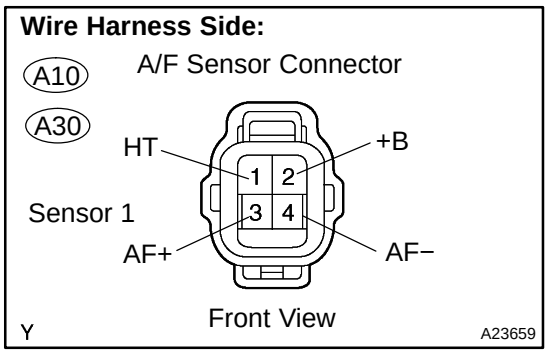
Standard:

Terminal No.	Condition	Specified Condition
3 − 5	Always	10 KΩ or higher
3 − 5	Apply B+ between terminals 1 and 2	Below 1 Ω

NG → **Replace A/F relay.**

OK

13	Check for open and short in harness and connector between ECM and A/F sensor.



PREPARATION:

(a) Disconnect the A10 or A30 A/F sensor connector.

(b) Turn the ignition switch to ON.

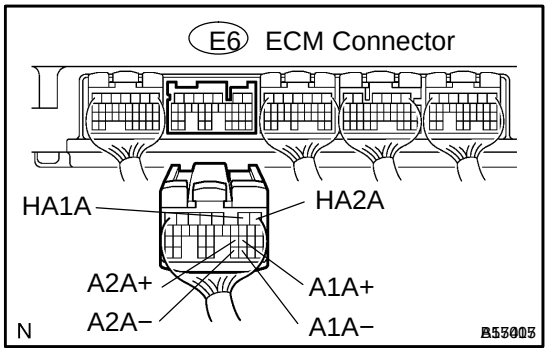
CHECK:

(a) Measure the voltage between the +B terminal of the A/F sensor connector and body ground.

OK:

Standard:

Tester Connections	Specified Conditions
+B (2) − Body ground	9 to 14 V



PREPARATION:

(a) Turn the ignition switch to OFF.

(b) Disconnect the E6 ECM connector.

CHECK:

(a) Check the resistance.

OK:

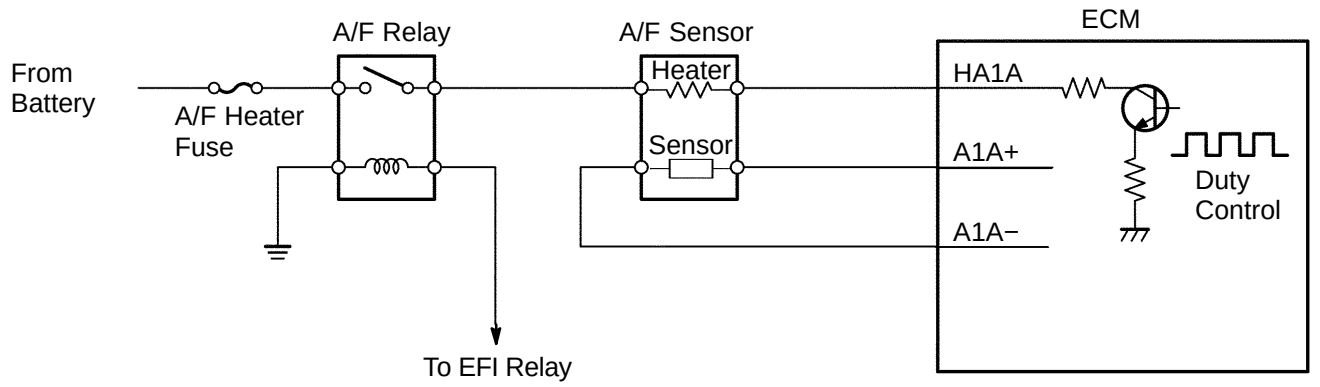
Standard (Check for open):

Tester Connections	Specified Conditions
HT (A10−1) − HA1A (E6−2) HT (A30−1) − HA2A (E6−1)	Below 1 Ω
AF+ (A10−3) − A1A+ (E6−22) AF+ (A30−3) − A2A+ (E6−23)	Below 1 Ω
AF− (A10−4) − A1A− (E6−30) AF− (A30−4) − A2A− (E6−31)	Below 1 Ω

Standard (Check for short):

Tester Connections	Specified Conditions
HT (A10−1) or HA1A (E6−2) − Body ground HT (A30−1) or HA2A (E6−1) − Body ground	10 kΩ or higher
AF+ (A10−3) or A1A+ (E6−22) − Body ground AF+ (A30−3) or A2A+ (E6−23) − Body ground	10 kΩ or higher
AF− (A10−4) or A1A− (E6−30) − Body ground AF− (A30−4) or A2A− (E6−31) − Body ground	10 kΩ or higher

Reference (Bank 1 Sensor 1 System Drawing):



P A23512

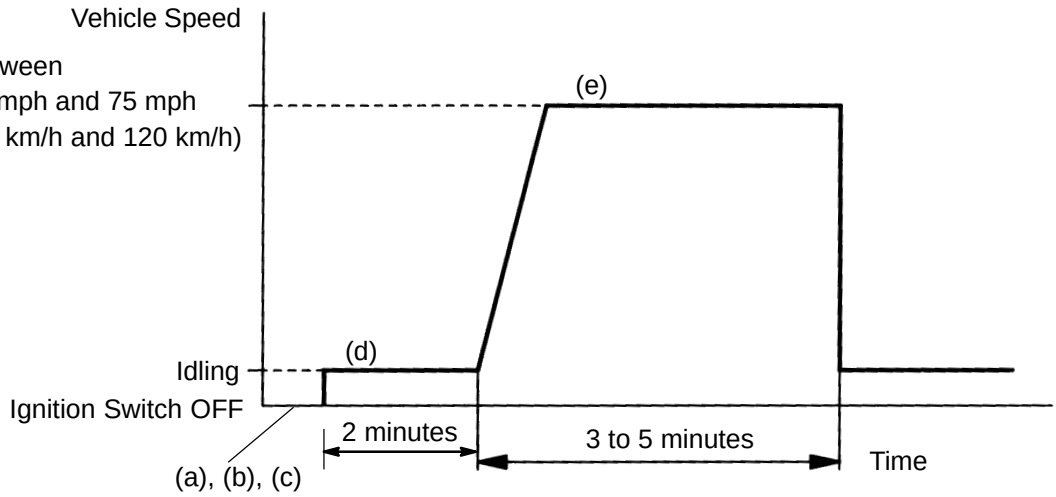
NG → **Replace or replace harness or connector.**

OK →

14	**Replace air fuel ratio sensor.**

NEXT →

15	Perform confirmation driving pattern.



(a) Connect the hand−held tester to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Clear DTCs (see page DI−462).
(d) Switch the ECM from normal mode to check mode using the tester (see page DI−463).
(e) Start the engine and warm it up with all the accessories switched OFF.
(f) Drive the vehicle at between 38 mph and 75 mph (60 km/h and 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes.

HINT:
If the system is still malfunctioning, the MIL will be illuminated during step (e).

NOTICE:
If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16	Check whether DTC output recurs (DTC P0171, P0172, P0174 or P0175)

CHECK:
(a) On the hand−held tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(b) Read DTCs.

RESULT:

Display (DTC Output)	Proceed To
P0171, P0172, P0174 or P0175	A
No output	B

B → **Go to step 5.**

A

END