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 includes the short-term fuel trim and the long-term fuel trim.

The short-term fuel trim is the short-term fuel compensation used to maintain the air-fuel ratio at its ideal theoretical value. The signal from the heated oxygen sensor indicates whether the air-fuel ratio is RICH or LEAN compared to the ideal theoretical value, triggering a reduction in the fuel volume if the air-fuel ratio is RICH, and an increase in the fuel volume if it is LEAN.

The long-term fuel trim is the overall fuel compensation carried out in long-term to compensate for a continual deviation of the short-term fuel trim from the central value, due to individual engine differences, wear overtime and changes in the using environment.

If both the short-term fuel trim and the long-term fuel trim are LEAN or RICH beyond a certain value, it is detected as a malfunction and the MIL is illuminated.

DTC No.	DTC Detection Condition	Trouble Area
P0171 P0174	When air-fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on LEAN side (2 trip detection logic)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temp. sensor • Fuel pressure • Gas leakage in exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F sensor heater relay • PCV valve and hose • PCV hose connection
P0172 P0175	When air-fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on RICH side (2 trip detection logic)	• Injector leak, blockage • Mass air flow meter • Engine coolant temp. sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater • A/F sensor heater relay

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” is 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 % (75 °C), the system is functioning normally.

WIRING DIAGRAM

Refer to DTC P2195 on page 05-195 .

INSPECTION PROCEDURE

HINT:

Hand-held tester only:

Narrowing down the trouble area is possible by performing ACTIVE TEST of the following ”A/F CONTROL” (A/F sensor, heated oxygen sensor or other trouble areas can be distinguished).

(a) Perform ACTIVE TEST by the hand-held tester (A/F CONTROL).

HINT:

”A/F CONTROL” is an ACTIVE TEST which changes the injection volume to -12.5 % or +25 %.

(1) Connect the hand-held tester to the DLC3 on the vehicle.

(2) Turn the ignition switch ON.

(3) Warm up the engine with the engine speed at 2,500 rpm for approx. 90 sec.

(4) Select the item ”DIAGNOSIS/ENHANCED OBD II/ACTIVE TEST/ A/F CONTROL”.

(5) Perform ”A/F CONTROL” when idle condition (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:

+25 % → rich output: Less than 3.0 V

-12.5 % → lean output: More than 3.35 V

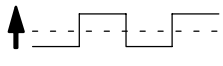
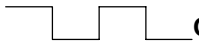
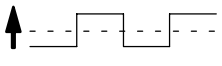
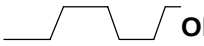
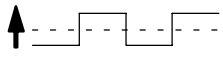
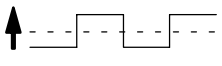
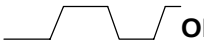
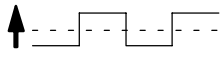
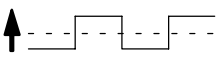
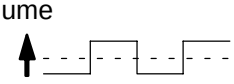
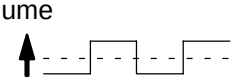
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:

+25 % → rich output: More than 0.55 V

-12.5 % → lean output: Less than 0.4 V

NOTICE:

However, there is a few second delay in the A/F sensor output. And there is about 20 seconds delay in the heated oxygen sensor output.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Mainly suspect trouble area
Case 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**	—
Case 2	Injection volume +25 % -12.5 %  Output voltage 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)
Case 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 No reaction **NG**	Heated oxygen sensor (heated oxygen sensor, heater, heated oxygen sensor circuit)
Case 4	Injection volume +25 % -12.5 %  Output voltage No reaction **NG**	Injection volume +25 % -12.5 %  Output voltage No reaction **NG**	Extremely rich or lean of the actual air-fuel ratio (Injector, fuel pressure, gas leakage in exhaust system, etc.)

The following procedure of A/F CONTROL enables the user to check its output (show its graph indication) of A/F sensor and heated oxygen sensor.
For displaying the graph indication, enter ”ACTIVE TEST/ A/F CONTROL/USER DATA”, then select ”AFS B1S1 and O2S B1S2” or ”AFS B2S1 and O2S B2S2” by pressing ”YES” button and push ”ENTER” button before pressing ”F4” button.
HINT:

- If different DTCs that are related to a different system are output simultaneously while terminal E2 is used as a ground terminal, terminal E2 may be open.
- Read freeze frame data using the hand−held tester or the OBD II scan tool, as freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.
- A high heated oxygen sensor (sensor 1) voltage (0.55 V or more) could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A low heated oxygen sensor (sensor 1) voltage (0.4 V or less) could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1	CHECK AIR INDUCTION SYSTEM

(a) Check the vacuum leaks in air induction system.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

2	CHECK CONNECTION OF PCV HOSE

NG → REPAIR OR REPLACE PCV HOSE

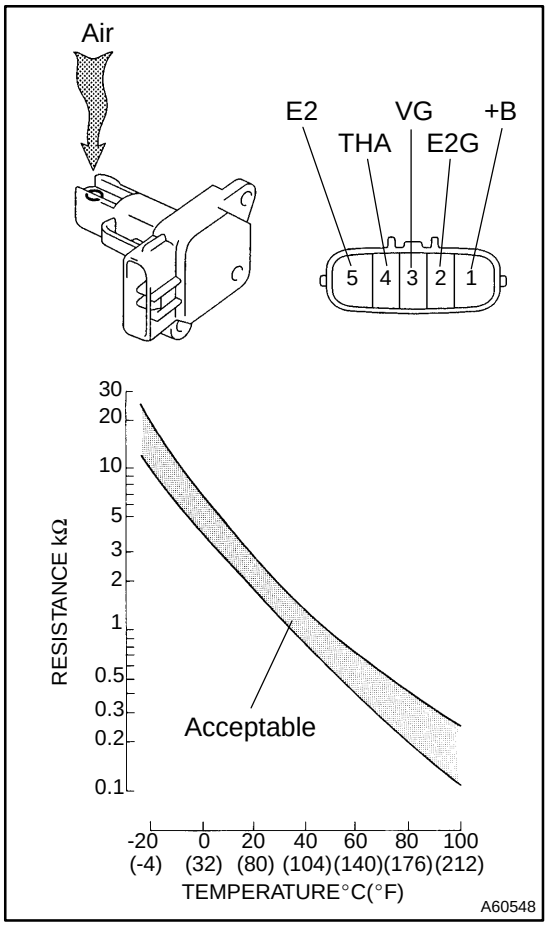
OK

3	INSPECT FUEL INJECTOR ASSY(INJECTION AND VOLUME) (See page 11-7)

NG → REPLACE FUEL INJECTOR ASSY

OK

4	INSPECT MASS AIR FLOW METER



(a) Output voltage inspection.
  (1) Apply battery voltage across terminals +B and E2G.
  (2) Connect the positive (+) tester prove to terminal VG, and negative (-) tester prove to terminal E2G.
  (3) Blow air into the mass air flow meter, and check that the voltage fluctuates.

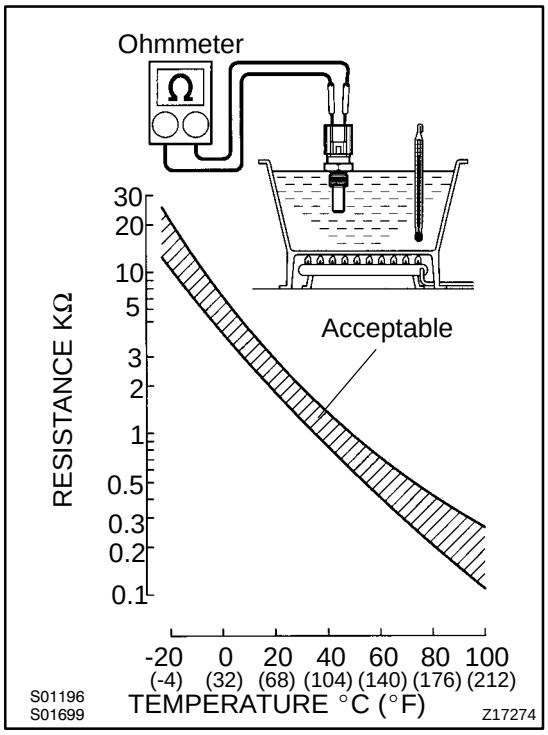
(b) Resistance inspection.
  (1) Measure the resistance between terminals THA and E2.

Resistance:
13.6 to 18.4 kΩ at -20°C (-4 °F)
2.21 to 2.69 kΩ at 20°C (68°F)
0.49 to 0.67 kΩ at 60°C (140°F)

NG → REPLACE MASS AIR FLOW METER

OK

5	INSPECT ENGINE COOLANT TEMPERATURE SENSOR(RESISTANCE)



(a) Measure the resistance between terminals.
Resistance:
2.32 to 2.59 kΩ at 20 °C (68 °F)
0.310 to 0.326 kΩ at 80 °C (176 °F)

NOTICE:
In case of checking the engine coolant temperature sensor in the water, be careful not to allow water to go into the terminals, and after checking, wipe out the sensor.

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

6	CHECK FOR SPARK AND IGNITION (See page 18-1)

NG → **REPAIR OR REPLACE**

OK

7	CHECK FUEL PRESSURE (See page 11-5)

(a) Check the fuel pressure (high or low pressure).

NG → **CHECK AND REPLACE FUEL SYSTEM**

OK

8	CHECK FOR EXHAUST GAS LEAKAGE

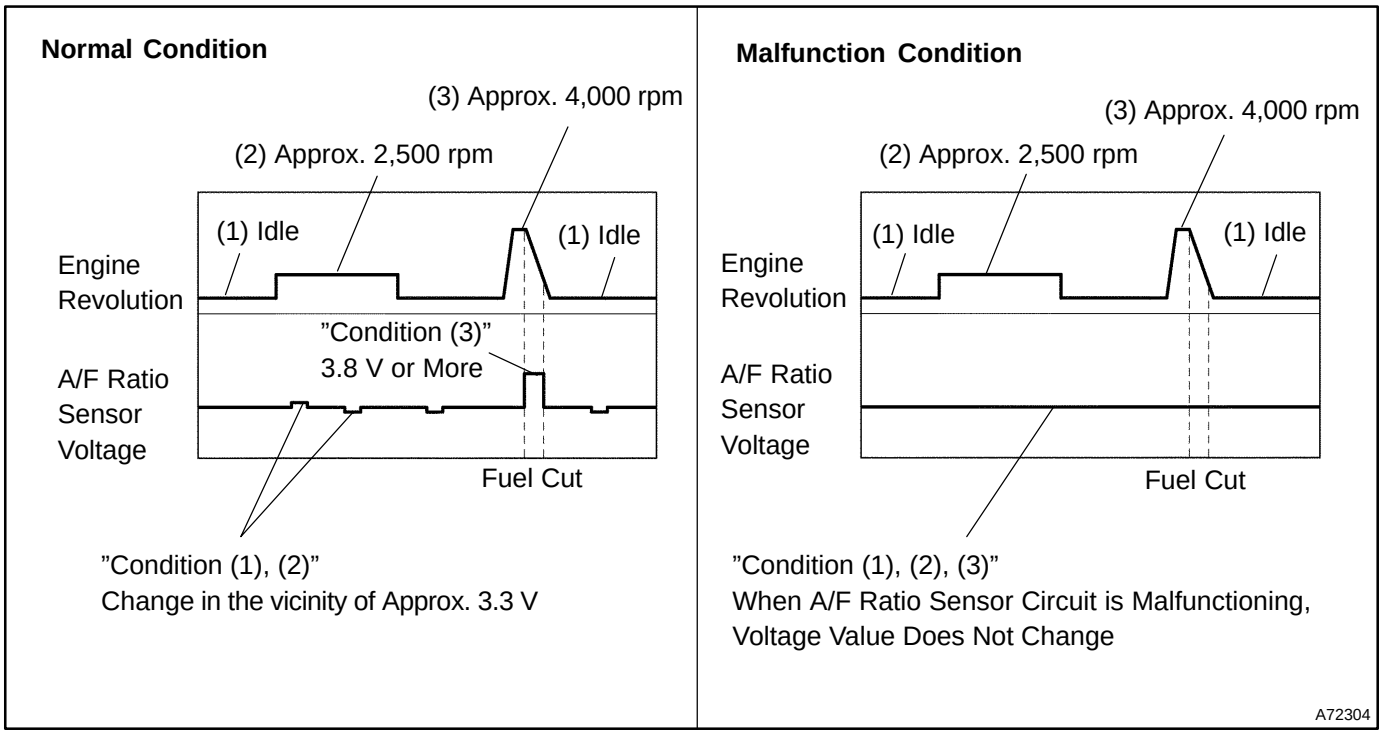
NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT (See page 15-2)**

OK

9	READ VALUE OF HAND-HELD TESTER OR OBD II SCAN TOOL(OUTPUT VOLTAGE OF AIR FUEL RATIO SENSOR (BANK 1, 2 SENSOR 1))

(a) Connect the hand-held tester or OBD II scan tool to the DLC 3.
(b) Warm up the A/F sensors (bank 1, 2 sensor 1) with the engine at 2,500 rpm for approximately 90 seconds.
(c) Read A/F sensor voltage on the OBD II scan tool or hand-held tester.
(d) Hand-held tester only:
Select the "ENHANCED OBD II/SNAPSHOT/MANUAL SNAPSHOT/USER DATA" mode on the hand-held tester.
(e) Select "AFS B1 S1 or AFS B2 S1/ENGINE SPD" and press button "YES".
(f) Monitor the A/F sensor voltage carefully.
(g) Check the A/F sensor voltage under the condition as follows.
(1) Allow engine to idle for 30 seconds.
(2) Engine is racing at approx. 2,500 rpm (when engine revolution is not suddenly changed).
(3) Raise the engine speed to 4,000 rpm and release the accelerator pedal fully closed quickly.

Standard:
Condition (1) and (2)
Voltage change in the vicinity of 3.3 V (0.66 V)* (between approx. 3.1 - 3.5 V) as shown in the illustration.
Condition (3)
A/F ratio sensor voltage increase to 3.8 V (0.76 V)* or more during engine deceleration (when fuel cut) as shown in the illustration.



HINT:

- Whenever the output voltage of the A/F sensor remains at approx. 3.3 V (0.660 V)* (see dwg. 2) under any conditions as well as the above conditions, the A/F sensor may have an open-circuit. (This will happen also when the A/F sensor heater has an open-circuit.)
- Whenever the output voltage of the A/F sensor remains at a certain value of approx. 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see dwg. 2) under any condition as well as the above conditions, the A/F sensor may have a short-circuit.

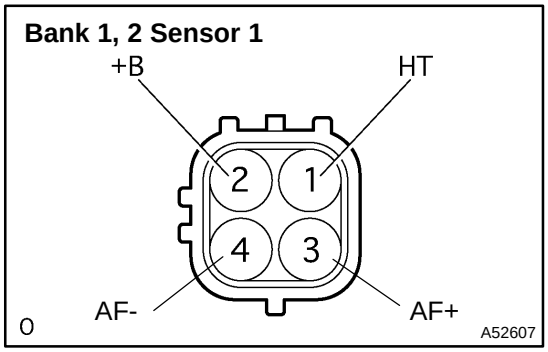
- The ECM will stop fuel injection (fuel cut) during engine deceleration. This will cause a lean condition and should result in a momentary increase in A/F ratio sensor voltage.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal has been disconnected, the vehicle must be driven over 10 mph to allow the ECM to relearn the closed throttle position.
- When the vehicle is driven:
  In the case that the output voltage of the A/F sensor is below 2.8 V (0.76 V)* during fuel enrichment (for example, when the vehicle tries to overtake another vehicle on a highway, the vehicle speed is suddenly increased with the accelerator pedal fully depressed), the A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F ratio sensor or ECM, you will obtain a constant voltage.

*: When using the OBD II scan tool (excluding hand-held tester).

OK → **Go to step 17**

NG

10 INSPECT AIR FUEL RATIO SENSOR(HEATER RESISTANCE)

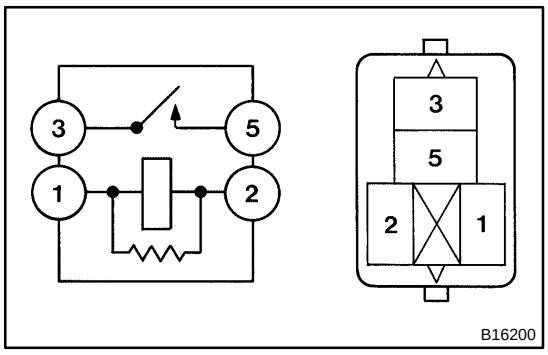


(a) Disconnect the air fuel ration sensor connector.
(b) Measure resistance between the terminals HT and +B of the air fuel ratio sensor.
Resistance: 1.8 to 3.4 Ω (20 °C)

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

11 INSPECT AIR FUEL RATIO SENSOR HEATER RELAY



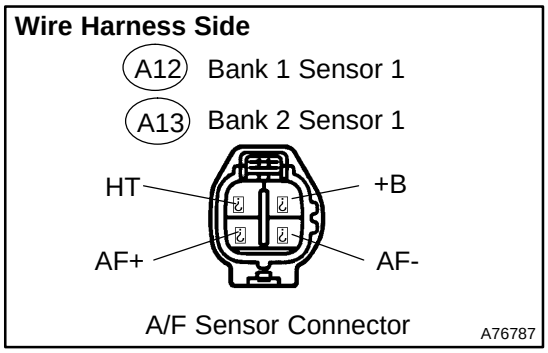
(a) Remove the A/F sensor heater relay from the engine room R/B.
(b) Inspect the A/F sensor heater relay.
Standard:

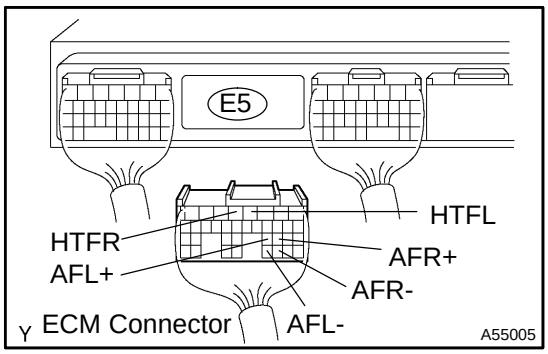
Terminal No.	Specified condition
1 - 2	Continuity
3 - 5	No Continuity
	Continuity (Apply battery voltage terminals 1 and 2)

NG → **REPLACE AIR FUEL RATIO SENSOR HEATER RELAY**

OK

12 CHECK HARNESS AND CONNECTOR(A/F SENSOR - ECM)





(a) Disconnect the A12 or A13 heated oxygen sensor connector.
(b) Disconnect the E5 ECM connector.
(c) Check for continuity between the wire harness side connectors.

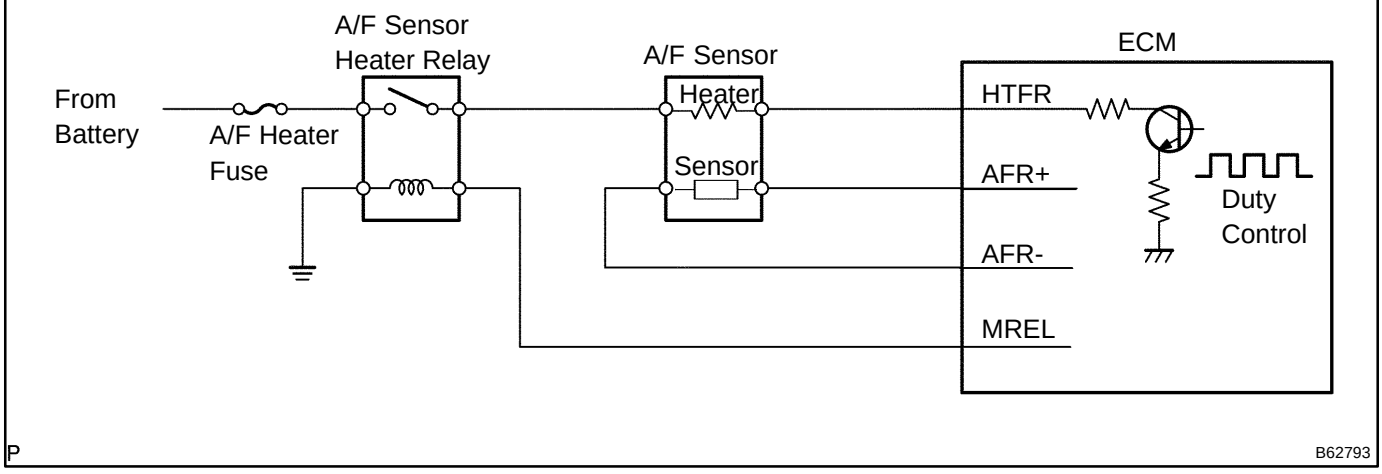
Standard (Check for open):

Symbols (Terminal No.)	Specified condition
AF+ (A12-3) - AFR+ (E5-22)	Continuity
AF- (A12-4) - AFR- (E5-30)	
HT (A12-1) - HAFR (E5-5)	
AF+ (A13-3) - AFL+ (E5-23)	
AF- (A13-4) - AFL- (E5-31)	
HT (A13-1) - HAFL (E5-4)	

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
AF+ (A12-3) or AFR+ (E5-22) - Body ground	No continuity
AF- (A12-4) or AFR- (E5-30) - Body ground	
HT (A12-1) or HTFR (E5-5) - Body ground	
AF+ (A13-3) or AFL+ (E5-23) - Body ground	
AF- (A13-4) or AFL- (E5-31) - Body ground	
HT (A13-1) or HTFL (E5-4) - Body ground	

Reference (Bank 1 Sensor 1 System Drawing)



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

OK

13 REPLACE AIR FUEL RATIO SENSOR

GO

14	PERFORM CONFIRMATION DRIVING PATTERN (See page 05-195)

HINT:
Clear all DTCs prior to perform the confirmation driving pattern (See page 05-195).

GO

15	READ OUTPUT DTC(DTC P0171, P0172, P0174 AND/OR P0175 ARE OUTPUT AGAIN)

(a) Read the DTC using the hand-held tester or the OBD II scan tool.
Result:

Display (DTC output)	Proceed to
DTC "P0171, P0172, P0174 and/or P0175" are not output again	A
DTC "P0171, P0172, P0174 and/or P0175" are output again	B

B → **CHECK AND REPLACE ECM (See page 01-35) AND PERFORM CONFIRMATION DRIVING PATTERN (See page 05-195)**

A

16	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05-5)**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL (DTCS P0171, P0172, P0174 AND/OR P0175)

17	PERFORM CONFIRMATION DRIVING PATTERN (See page 05-195)

HINT:
Clear all DTCs prior to perform the confirmation driving pattern (See page 05-195).

GO

18	READ OUTPUT DTC(DTC P0171, P0172, P0174 AND/OR P0175 ARE OUTPUT AGAIN)

(a) Read the DTC using the hand-held tester or the OBD II scan tool.
Result:

Display (DTC output)	Proceed to
DTC "P0171, P0172, P0174 and/or P0175" are output again	A
DTC "P0171, P0172, P0174 and/or P0175" are not output again	B

B → **Go to step 22**

A

19	REPLACE AIR FUEL RATIO SENSOR

GO

20	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to perform the confirmation driving pattern (See page 05-195).

GO

21	READ OUTPUT DTC(DTC P0171, P0172, P0174 AND/OR P0175 ARE OUTPUT AGAIN)

(a) Read the DTC using the hand-held tester or the OBD II scan tool.
Result:

Display (DTC output)	Proceed to
DTC "P0171, P0172, P0174 and/or P0175" are not output again	A
DTC "P0171, P0172, P0174 and/or P0175" are output again	B

B → **CHECK AND REPLACE ECM (See page 01-35) AND PERFORM CONFIRMATION DRIVING PATTERN (See page 05-195)**

A

22	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS (See page 05-5)**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL (DTCS P0171, P0172, P0174 AND/OR P0175)