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.

INSPECTION PROCEDURE

HINT:
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 Intelligent Tester II.

(1) Connect a Intelligent Tester II 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: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(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.

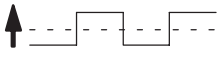
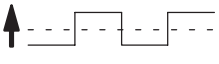
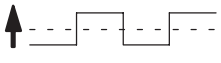
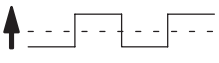
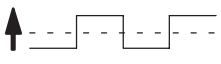
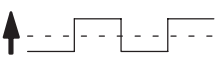
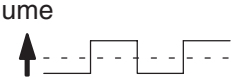
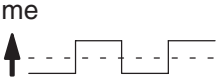
HINT:

- 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.
  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:

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 Intelligent Tester II. 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 OTHER DTC OUTPUT(in addition to DTC P0171, P0172, P0174 or P0175)

(a) Connect a Intelligent Tester II to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: Powertrain / Engine and ECT / DTC.
(d) 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**

A

2	CHECK CONNECTION OF PCV HOSE

OK: PCV hose is connected correctly and is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

3	CHECK AIR INDUCTION SYSTEM

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 Intelligent Tester II 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: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(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 INTELLIGENT TESTER II(Engeine coolant temperature)

(a) Connect the Intelligent Tester II to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: Powertrain / Engine and ECT / Data List / Coolant Temp.
(d) 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 ECT SENSOR**

OK

6	READ VALUE OF INTELLIGENT TESTER II(Mass air flow meter)

(a) Connect the Intelligent Tester II to the DLC3.
(b) Turn the ignition switch to ON and turn the tester ON.
(c) Select the following menu items: Powertrain / Engine and ECT / Data List / Coolant Temp and MAF.
(d) Allow the engine to idle until the Coolant Temp reaches 75°C (167°F) or more.
(e) 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 MAF METER**

OK

7	CHECK FUEL PRESSURE

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

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	CHECK FOR EXHAUST GAS LEAKS

(a) Check for exhaust gas leakage from the exhaust manifold and pipe.
OK:
No exhaust gas leakage.

NG → **REPAIR OR REPLACE EXHAUST SYSTEM**

OK

9	CHECK FOR SPARK AND IGNITION

HINT:
If the spark plugs or ignition system malfunction, engine misfire may occur. The misfire counter can be read with the Intelligent Tester II. Enter the following menus: Powertrain / Engine and ECT / Data List / Cylinder #1 (to #6) Misfire Rate.

NG → **REPAIR OR REPLACE IGNITION SYSTEM**

OK

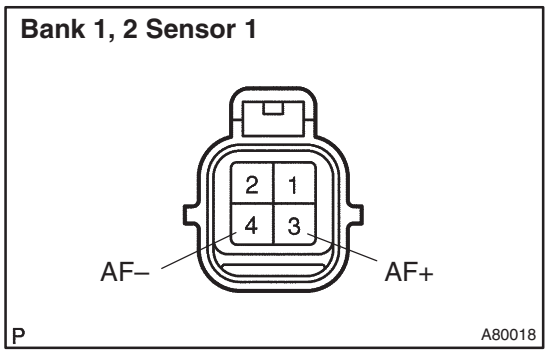
10	INSPECT FUEL INJECTOR

HINT:
If the injectors malfunction, engine misfires may occur. The misfire counter can be read with the Intelligent Tester II. Enter the following menus: Powertrain / Engine and ECT / Data List.

NG → **REPLACE FUEL INJECTOR ASSY**

OK

11	INSPECT A/F SENSOR(Heater resistance)

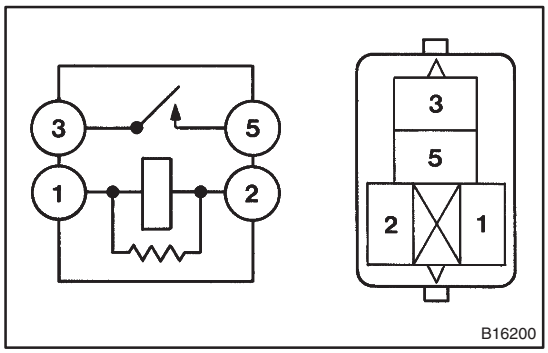


(a) Disconnect the A/F sensor connector.
(b) Measure resistance between terminals HT and +B of the A/F sensor.
Resistance: 1.8 to 3.4 Ω (20 °C)

NG → **REPLACE A/F SENSOR**

OK

12 INSPECT A/F RELAY



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

(b) Inspect the A/F sensor heater relay.

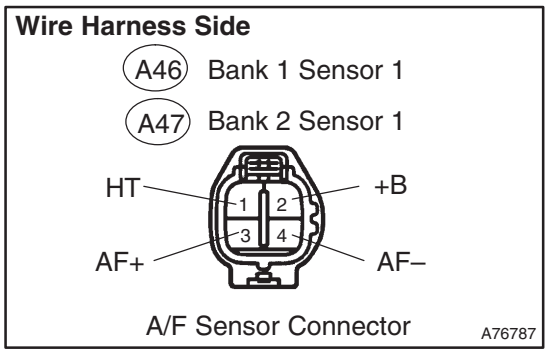
Standard:

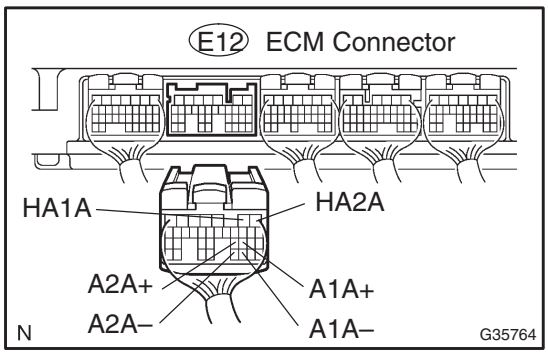
Terminal No.	Specified condition
1 – 2	Continuity
3 – 5	No Continuity
	Continuity (Apply battery voltage terminals 1 and 2)

NG → **REPLACE A/F RELAY**

OK

13 CHECK WIRE HARNESS(ECM – A/F Sensor)





(a) Disconnect the A46 or A47 heated oxygen sensor connector.
(b) Disconnect the E12 ECM connector.
(c) Check for continuity between the wire harness side connectors.

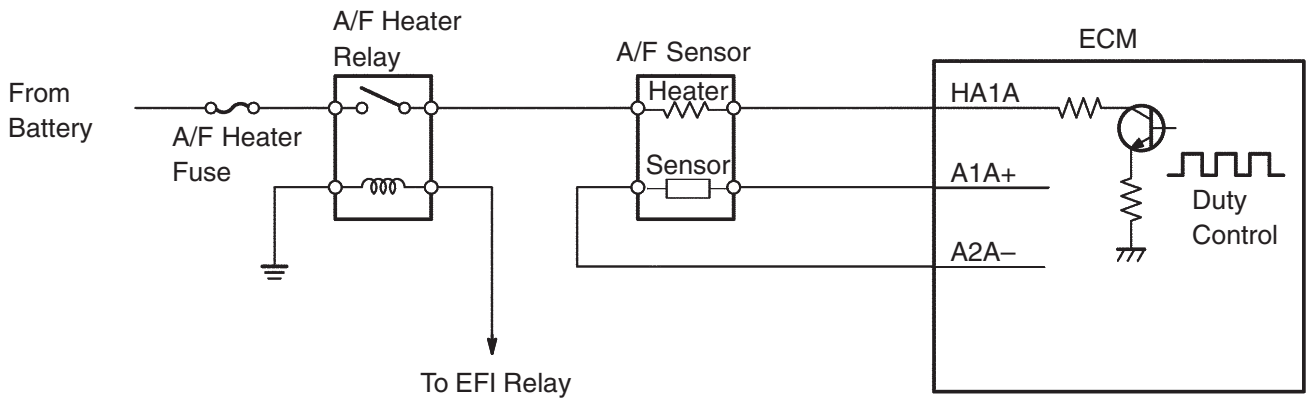
Standard (Check for open):

Symbols (Terminal No.)	Specified condition
AF+ (A46–3) – A1A+ (E12–22)	Continuity
AF– (A46–4) – A1A– (E12–30)	
HT (A46–1) – HA1A (E12–2)	
AF+ (A47–3) – A2A+ (E12–23)	
AF– (A47–4) – A2A– (E12–31)	
HT (A47–1) – HA2A (E12–1)	

Standard (Check for short):

Symbols (Terminal No.)	Specified condition
AF+ (A46–3) or A1A+ (E12–22) – Body ground	No continuity
AF– (A46–4) or A1A– (E12–30) – Body ground	
HT (A46–1) or HA1A (E12–2) – Body ground	
AF+ (A47–3) or A2A+ (E12–23) – Body ground	
AF– (A47–4) or A2A– (E12–31) – Body ground	
HT (A47–1) or HA2A (E12–1) – Body ground	

Reference (Bank 1 Sensor 1 System Drawing)



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

OK

14 REPLACE HEATED OXYGEN SENSOR

NEXT

15	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

16	CHECK WHETHER DTC OUTPUT RECURS(DTC P0171, P0172, P0174 OR PO175)

(a) Connect the Intelligent Tester II to the DLC3.
(b) Turn the ignition switch ON.
(c) Turn the Intelligent Tester II ON.
(d) On the Intelligent Tester II, select the item: Powertrain / Engine and ECT / DTC / Pending.
(e) Read DTCs.

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 → Go to step 5

A

END