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 stoichiometric air−fuel ratio. The signal from the A/F sensor indicates whether the air−fuel ratio is RICH or LEAN compared to the stoichiometric air−fuel ratio. This variance triggers 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 short−term fuel trim varies from the central value due to individual engine differences, wear over time and changes in the operating environment. The long−term fuel trim, which controls overall fuel compensation, steadies long−term deviations of the short−term fuel trim from the central value.

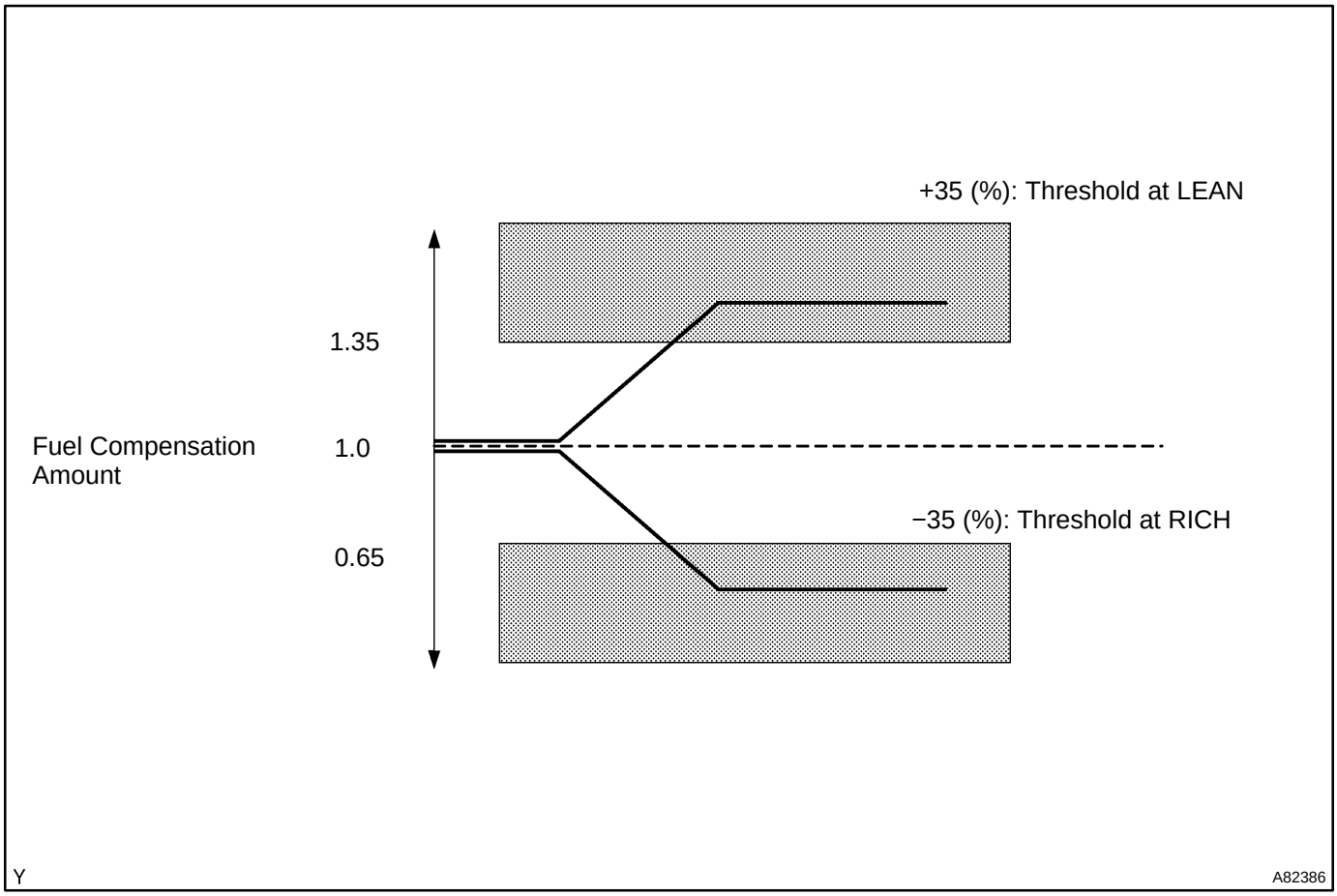
If both the short−term fuel trim and the long−term fuel trim are LEAN or RICH beyond a certain value, it is detected as a malfunction and the MIL is illuminated and a DTC is set.

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 • MAF meter • ECT 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 HTR 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 • MAF meter • ECT 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 HTR 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 may be recorded. The MIL then illuminates.
- 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 amounts that deviate from the ECM's estimated fuel amount will cause a change in the long−term fuel trim compensation value. This long−term fuel trim is adjusted when there are persistent deviations in the short−term fuel trim values. And the deviation from the simulated fuel injection amount by the ECM affects a smoothed fuel trim learning value. The smoothed fuel trim learning value is the combination of smoothed short−term fuel trim (fuel feedback compensation value) and smoothed long−term fuel trim (learning value of the air−fuel ratio). When the smoothed fuel trim learning value exceeds the DTC threshold, the ECM interprets this as a fault in the fuel system and sets a DTC.
Example:
The smoothed fuel trim learning value is more than +35% or less than −35%. The ECM interprets this as a failure in the fuel system.

MONITOR STRATEGY

Related DTCs	P0171: Fuel Trim Lean (Bank 1) P0172: Fuel Trim Rich (Bank 1) P0174: Fuel Trim Lean (Bank 2) P0175: Fuel Trim Rich (Bank 2)
Required sensors / components (Main)	Fuel system
Required sensors / components (Related)	A/F sensor, MAF meter, Crankshaft position sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	See page 05−507
Battery voltage	11 V or more
Fuel system status	Closed Loop
Either of the following conditions is met:	Condition 1 or 2
1. Engine RPM	Less than 1,100 rpm
2. Intake air amount per revolution	0.22 g/rev or more

TYPICAL MALFUNCTION THRESHOLDS

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 P2195 on page 05−771.

INSPECTION PROCEDURE

HINT:

Hand−held tester only:

It is possible the malfunctioning area can be found using the ACTIVE TEST A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble areas are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.

HINT:

The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

(1) Connect the hand−held tester to the DLC3 on the vehicle.
(2) Turn the ignition switch ON.
(3) Warm up the engine by running the engine at 2,500 rpm for approximately 90 seconds.
(4) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(5) Perform the A/F CONTROL operation with the engine idle (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

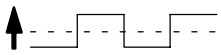
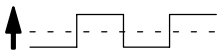
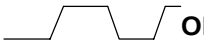
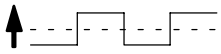
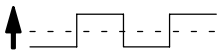
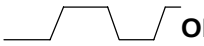
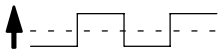
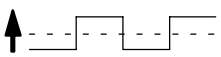
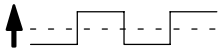
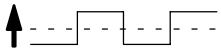
−12.5 % → LEAN output: More than 3.35 V

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:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay.

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

The following A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the A/F sensor and the heated oxygen sensor.
For displaying the graph, enter ”ACTIVE TEST / A/F CONTROL / USER DATA”, select ”AFS B1S1 and O2S B1S2” by pressing ”YES” and push ”ENTER”. Then press ”F4”.
HINT:

- Read freeze frame data using the hand−held tester or the OBD II scan tool. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, 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 high A/F sensor voltage could be caused by a RICH air−fuel mixture. Check the conditions that would cause the engine to run with a RICH air−fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air−fuel mixture. Check the conditions that would cause the engine to run with a LEAN air−fuel mixture.

1	CHECK AIR INDUCTION SYSTEM

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

OK: No vacuum leak.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

2	CHECK CONNECTION OF PCV HOSE

OK: PCV hose is connected correctly, And PCV hose is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

3	INSPECT FUEL INJECTOR ASSY (INJECTION AND VOLUME) (See page 11−29)

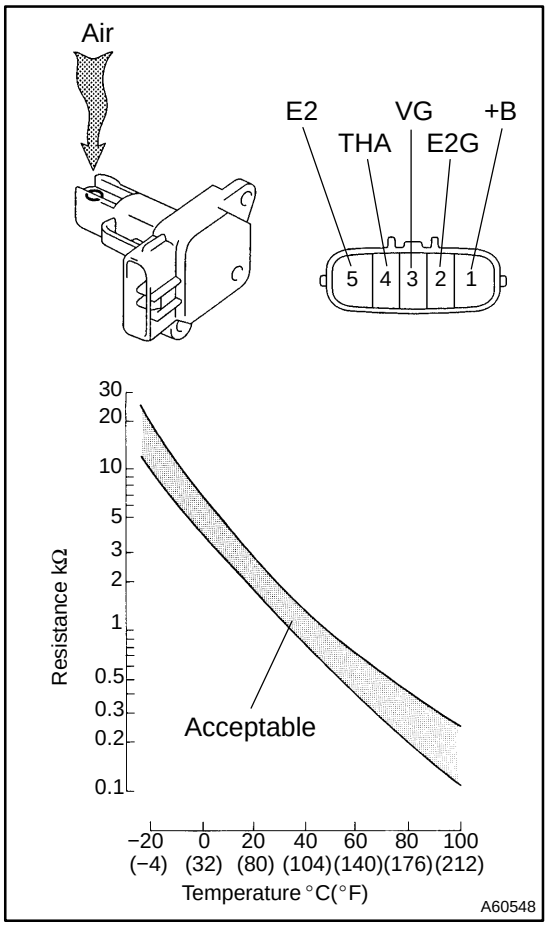
Standard:

Injection volume	Difference between each injector
60 to 73 cm^3 (3.7 to 4.5 cu in.) per 15 seconds	13 cm^3 (0.8 cu in.) or less

NG → **REPLACE FUEL INJECTOR ASSY (See page 11−29)**

OK

4 INSPECT MASS AIR FLOW METER



(a) Remove the MAF meter.

(b) Check the output voltage.

(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 MAF meter, and check that the voltage fluctuates.

(c) Check the resistance of the IAT sensor terminals.

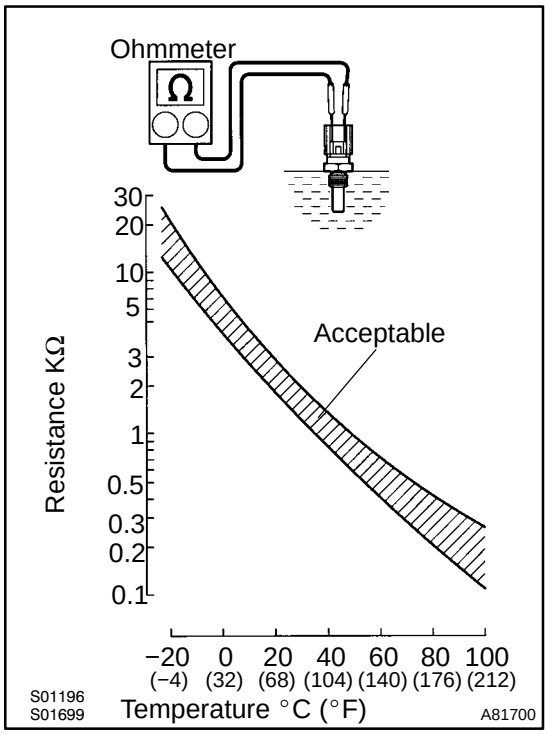
Standard:

Tester Connection	Condition	Specified Condition
THA (4) − E2 (5)	−20°C (−4°F)	13.6 to 18.4 kΩ
	20°C (68°F)	2.21 to 2.69 kΩ
	60°C (140°F)	0.49 to 0.67 kΩ

NG → **REPLACE MASS AIR FLOW METER**

OK

5 INSPECT ENGINE COOLANT TEMPERATURE SENSOR (RESISTANCE)



(a) Remove the ECT sensor.

(b) Check the resistance of the ECT sensor terminals.

Standard:

Tester Connection	Condition	Specified Condition
1 − 2	20°C (68°F)	2.32 to 2.59 kΩ
1 − 2	80°C (176°F)	0.310 to 0.326 kΩ

NOTICE:

When checking the ECT sensor in the water, be careful not to allow water to go into the terminals. After the check, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed ECT sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

6 CHECK FOR SPARK AND IGNITION (See page 18−7)

OK: Spark occurs.

NG → **REPAIR OR REPLACE**

OK

7 CHECK FUEL PRESSURE (See page 11−29)

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

Standard:

Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi).

NG → **REPLACE FUEL SYSTEM**

OK

8 CHECK FOR EXHAUST GAS LEAKAGE

OK: No gas leak.

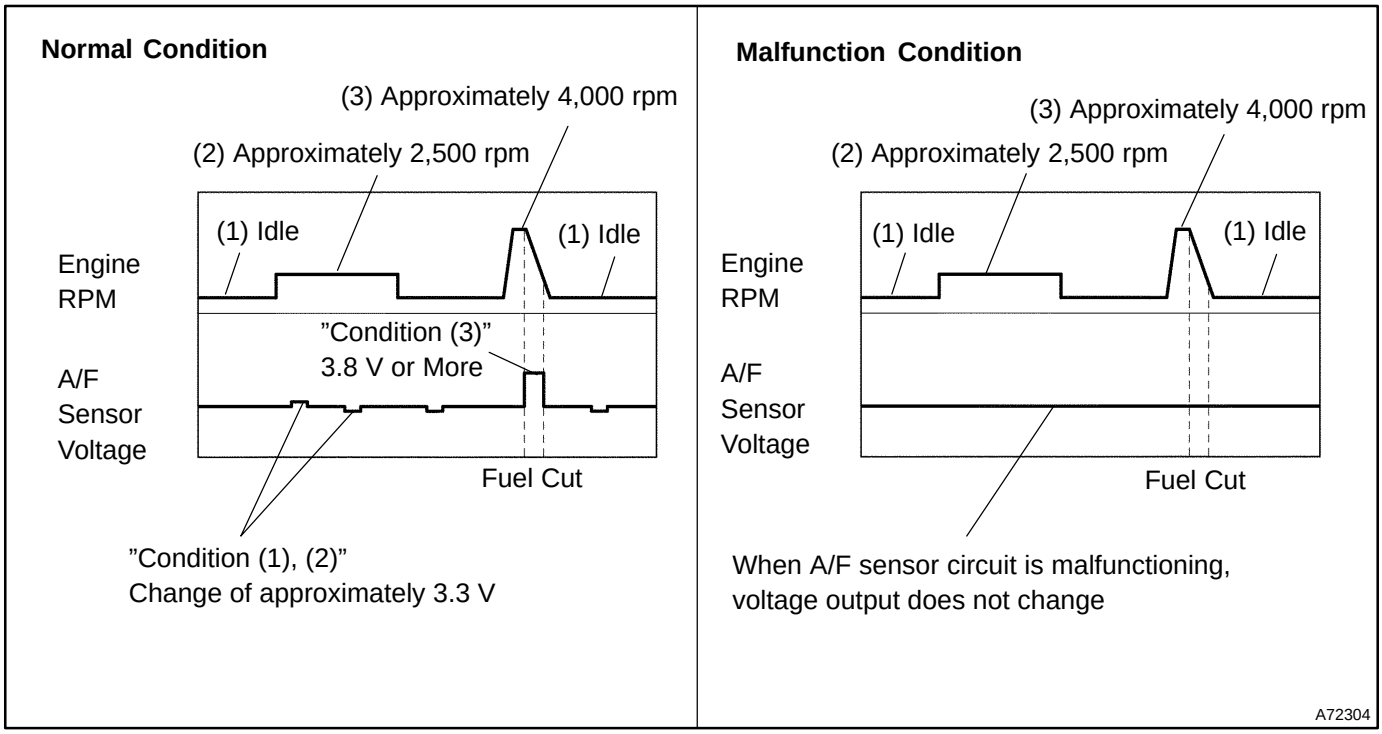
NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT (See page 15−7)**

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 the OBD II scan tool to the DLC 3.
(b) Warm up the A/F sensors (bank 1 sensor 1 and bank 2 sensor 1) by running the engine at 2,500 rpm for approximately 90 seconds.
(c) Read A/F sensor voltage output on the hand−held tester or the OBD II scan tool.
(d) Hand−held tester only:
Enter the following menus: ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(e) Select ”AFS B1 S1 or AFS B2 S1/ENGINE SPD” and press YES.
(f) Monitor the A/F sensor voltage carefully.
(g) Check the A/F sensor voltage output under the following conditions:
(1) Allow engine to idle for 30 seconds.
(2) Running the engine at approximately 2,500 rpm (where engine RPM is not suddenly changed).
(3) Raise the engine speed to 4,000 rpm and quickly release the accelerator pedal so that the throttle is fully closed.

Standard:
Condition (1) and (2)
Voltage change of 3.3 V (0.66 V)* (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (3)
A/F sensor voltage increases to 3.8 V (0.76 V)* or more when fuel is cut during engine deceleration, as shown in the illustration.
***: Voltage when using the OBD II scan tool.**



HINT:

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (0.660 V)* (see ”Malfunction Condition” graphic) under any condition 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).

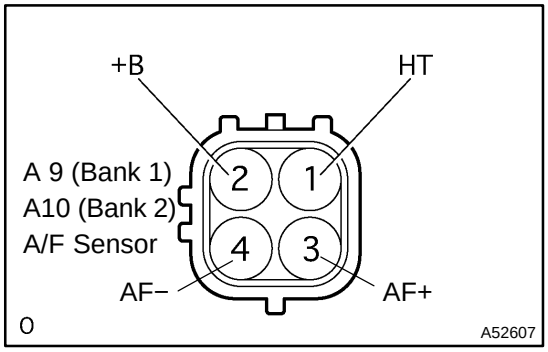
- Whenever the output voltage of the A/F sensor remains at a certain value of approximately 3.8 V (0.76 V)* or more, or 2.8 V (0.56 V)* or less (see ”Malfunction Condition” graphic) under any condition as well as the above conditions, the A/F sensor may have a short circuit.
- The ECM will stop fuel injection (fuel cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor voltage output.
- 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 learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V (0.76 V)* during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. 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 sensor or ECM, you will observe a constant voltage.

*: Voltage when using the OBD II scan tool.

OK → **Go to step 17**

NG

10 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



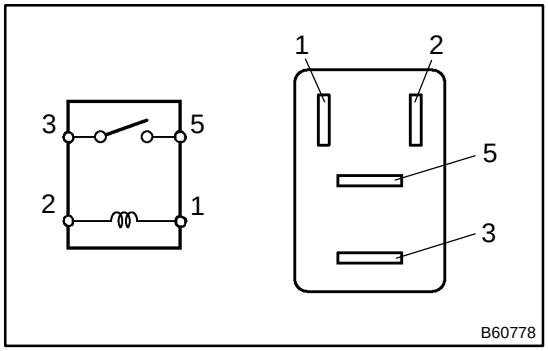
(a) Disconnect the A9 or A10 A/F sensor connector.
(b) Check the resistance of the A/F sensor terminals.
Standard:

Tester Connection	Condition	Specified Condition
1 (HT) − 2 (+B)	20°C (68°F)	0.8 to 1.4 Ω
1 (HT) − 2 (+B)	800°C (1,472°F)	1.8 to 3.4 Ω

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

11 INSPECT RELAY (A/F HTR)



(a) Remove the A/F HTR relay from the engine room R/B.
(b) Check the resistance of the A/F HTR relay.
Standard:

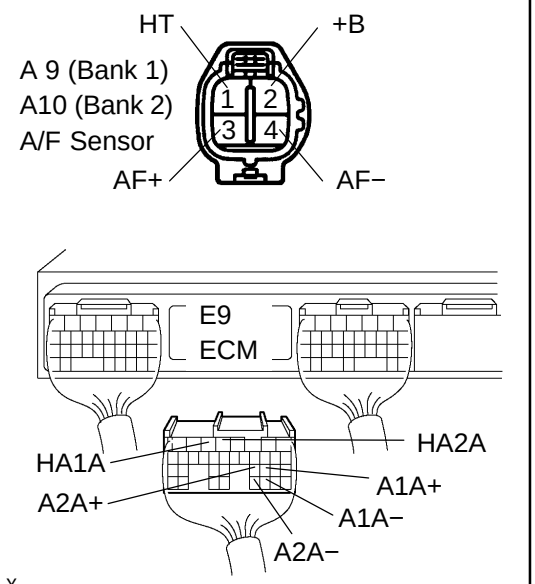
Tester Connection	Specified Condition
3 − 5	10 kΩ or higher
3 − 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG → **REPLACE RELAY**

OK

12 CHECK WIRE HARNESS (A/F SENSOR − ECM)

Wire Harness Side

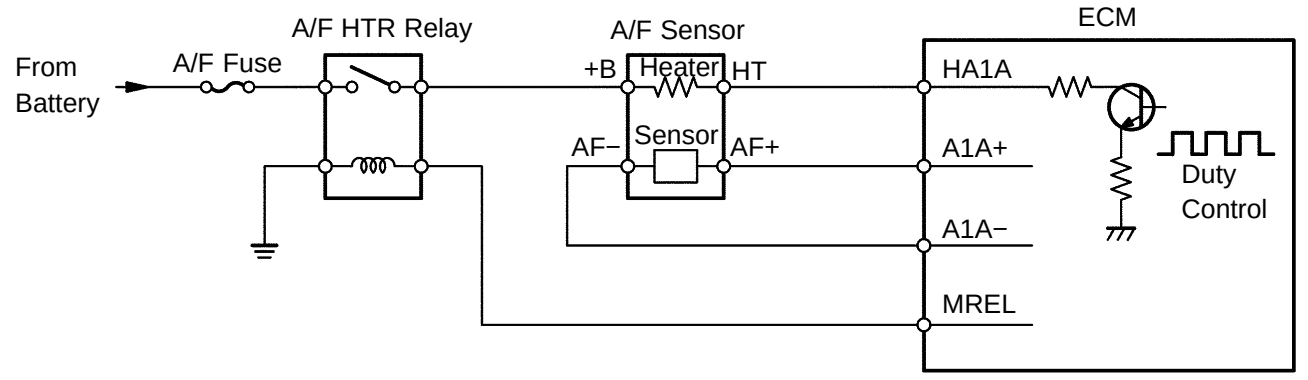


(a) Disconnect the A9 or A10 A/F sensor connector.
(b) Disconnect the E9 ECM connector.
(c) Check the resistance of the wire harness side connectors.

Standard:

Tester Connection	Specified Condition
A9−3 (AF+) − E9−22 (A1A+) A9−4 (AF−) − E9−30 (A1A−) A9−1 (HT) − E9−5 (HA1A) A10−3 (AF+) − E9−23 (A2A+) A10−4 (AF−) − E9−31 (A2A−) A10−1 (HT) − E9−4 (HA2A)	Below 1 Ω

Reference (Bank 1 Sensor 1 System Drawing)



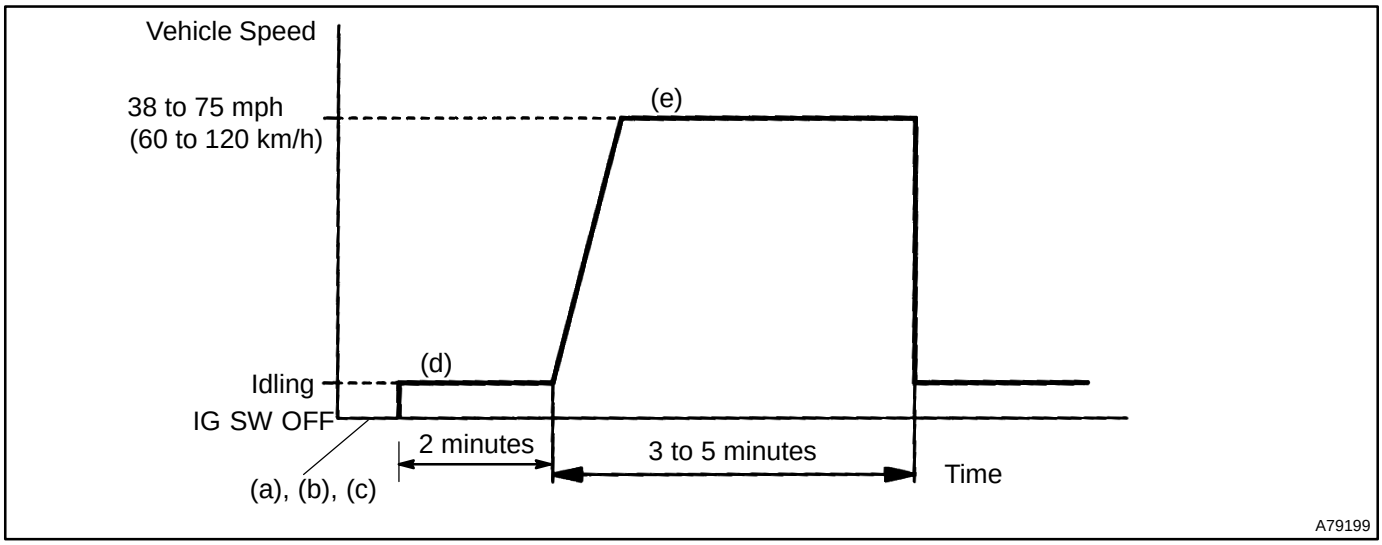
NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

13 REPLACE AIR FUEL RATIO SENSOR

GO

14	PERFORM CONFIRMATION DRIVING PATTERN



(a) Clear the DTCs.
  (1) Disconnect the battery cable or remove the EFI and ETCS fuses for 60 seconds or more.
(b) Connect the hand−held tester to the DLC3.
(c) Switch the hand−held tester from the normal mode to the check mode (see page 05−533).
(d) Start the engine and warm it up with all the accessory switches OFF.
(e) Drive the vehicle at 38 to 75 mph (60 to 120 km/h) and engine speed at 1,400 to 3,200 rpm for 3 to 5 minutes.

HINT:
If a malfunction exists, the MIL will be illuminated during step (e).

NOTICE:
If the conditions in this test are not strictly followed, detection of a malfunction will not occur. If you do not have a hand−held tester, turn the ignition switch OFF after performing steps (d) and (e), then perform step (e) again.

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 → **REPLACE ECM (See page 10−25) AND PERFORM CONFIRMATION DRIVING PATTERN (Refer to step 14)**

A

16	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (See page 05−500)

YES

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

17	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern (Refer to step 14).

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 not output again	A
DTC P0171, P0172, P0174 and/or P0175 are output again	B

B → Go to step 22

A

19	REPLACE AIR FUEL RATIO SENSOR

GO

20	PERFORM CONFIRMATION DRIVING PATTERN

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 output again	A
DTC ”P0171, P0172, P0174 and/or P0175” are not output again	B

B → REPLACE ECM (See page 10−25) AND PERFORM CONFIRMATION DRIVING PATTER (Refer to step 14)

A

22	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → CHECK FOR INTERMITTENT PROBLEMS (See page 05−500)

YES

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