DTC	P0420	CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)

CIRCUIT DESCRIPTION

The ECM uses 2 sensors mounted before and after the three–way catalytic converter (TWC) to monitor its' efficiency. The air–fuel ratio (A/F) sensor (sensor 1) sends pre–catalyst information to the ECM. The heated oxygen (O2) sensor (sensor 2) sends post–catalyst information to the ECM.

In order to detect deterioration in the catalyst, the ECM calculates Oxygen Storage Capacity (OSC) in the catalyst based on voltage output of the sensor 2 while performing "active air–fuel ratio control" instead of the conventional detecting method which uses the locus ratio.

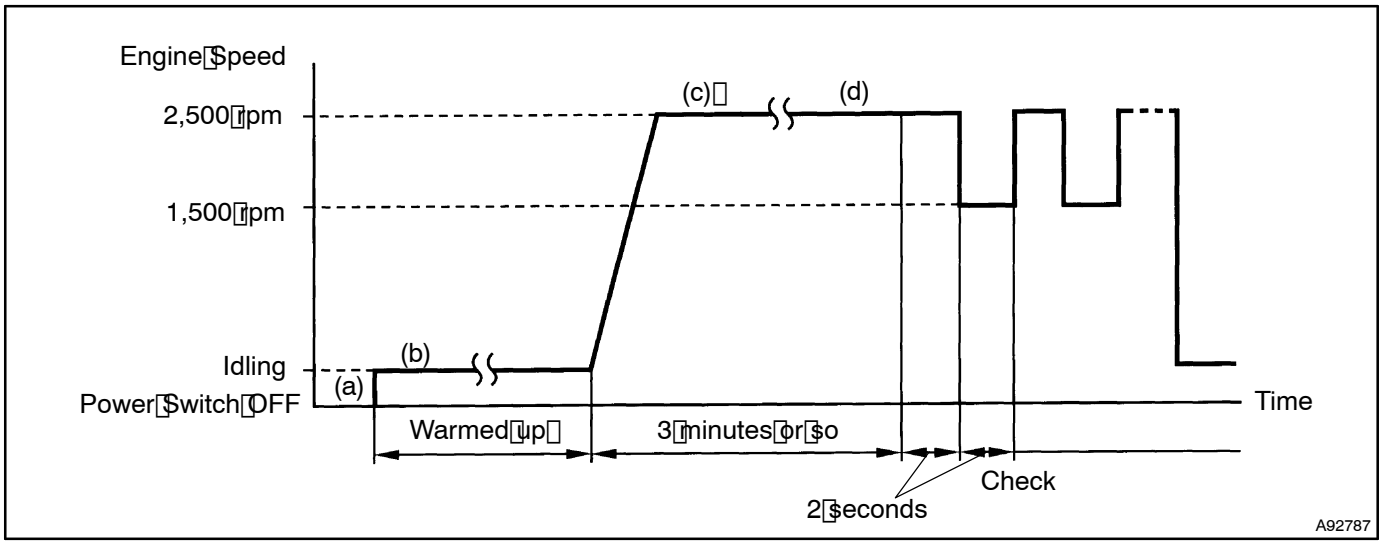
The OSC is an indication value of the catalyst oxygen storage capacity and is used for representing how much the catalyst can store oxygen. When the vehicle is being driven with a warm engine, the active air–fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the air–fuel ratio is forcibly regulated to go LEAN or RICH by the ECM, and if a RICH and LEAN cycle of the sensor 2 is long, the OSC will become greater. The greater OSC and capability of the catalyst are mutually related. The ECM judges if the catalyst has deteriorated based on the calculated OSC value. The ECM will illuminate the CHK ENG and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0420	OSC value is smaller than the standard value under "active air–fuel ratio control"	• Exhaust pipe with front and rear catalyst • Gas leakage in exhaust system • A/F sensor • Heated oxygen sensor

HINT:

- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

CONDITIONING THE A/F SENSOR AND HEATED OXYGEN SENSOR FOR TESTING



(a) Connect the intelligent tester II to the DLC3.
(b) Put the engine in inspection mode. (see page 05–1)
(c) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature becomes stable.
(d) Run the engine at 2,500 rpm for approximately for 3 minutes.
(e) Run the engine at 2,500 rpm for 2 seconds and 1,500 rpm for 2 seconds.
(f) Check waveform of the heated oxygen sensor (sensor 2).

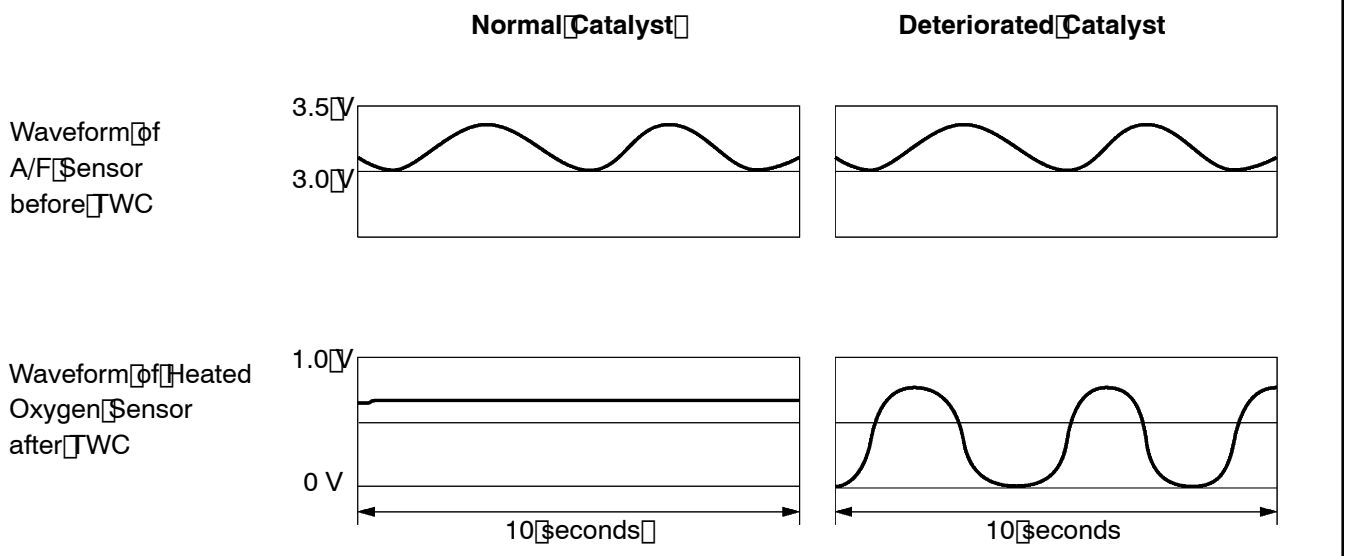
HINT:

If either output of the A/F sensor and the heated oxygen sensor does not fluctuate or has noise, the sensor may be malfunctioning.

If voltage output of both sensors remain at LEAN or RICH, the air–fuel ratio may be extremely LEAN or RICH. In such case, perform the following A/F Control in Active Test using the intelligent tester II.

If the catalyst has deteriorated, the voltage output of the heated oxygen sensor (located after the TWC) fluctuates up and down widely even under normal driving (”active air–fuel ratio control” is not performed).

Voltage output when "active air–fuel ratio control" is not performed:



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester II. Freeze frame data records the engine condition when 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.

1	CHECK OTHER DTC OUTPUT(IN ADDITION TO DTC P0420)

(a) Connect the intelligent tester II to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester II ON.
(d) On the intelligent tester II, select the item: Powertrain / Engine and ECT / DTC.
(e) Read DTCs.

Result:

Display (DTC Output)	Proceed to
P0420	A
P0420 and other DTCs	B

HINT:

If any other codes besides P0420 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART** (See page 05–39)

A

2	CHECK FOR EXHAUST GAS LEAKAGE

OK: No gas leakage.

NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT**

OK ↓

3	INSPECT AIR FUEL RATIO SENSOR (BANK 1 SENSOR 1) (See page 05–155)

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK ↓

4	INSPECT HEATED OXYGEN SENSOR (BANK 1 SENSOR 2) (See page 05–83)

OK: Heated oxygen sensor output fluctuates during closed–loop operation.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK ↓

REPLACE THREE–WAY CATALYTIC CONVERTER (REPLACE FRONT PIPE)

HINT:
Malfunctioning areas can be found by performing 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 Active Test using the intelligent tester II.

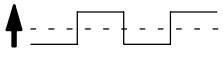
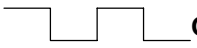
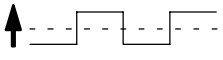
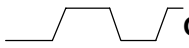
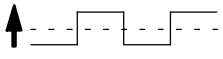
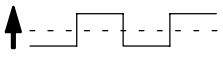
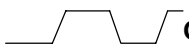
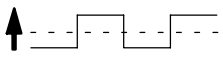
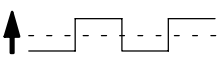
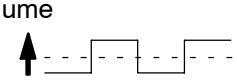
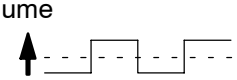
HINT:
The A/F CONTROL operation lowers the injection volume 12.5 % or increases the injection volume 25 %.

(1) Connect the intelligent tester II to the DLC3 on the vehicle.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page 05–1).
(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60 % for approximately 90 seconds.
(5) Enter the menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F Sensor.
(6) Select the monitor item: AFS B1S1 and O2S B1S2.
(7) Perform the A/F CONTROL operation with the engine in an 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:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

	Output voltage of A/F sensor (sensor 1)	Output voltage of heated oxygen sensor (sensor 2)	Main 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 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, sensor heater, 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, sensor heater, 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 output of both A/F sensor and heated oxygen sensor.
To display the graph, select the item on the tester: View / Line graph.