DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

MONITOR DESCRIPTION

The ECM uses the sensors mounted in front of and behind the three-way catalyst (TWC) to monitor its efficiency. The first sensor, an Air Fuel ratio (A/F) sensor, sends pre-catalyst A/F ratio information to the ECM. The second sensor, a heated oxygen sensor (O2S), sends post-catalyst information to the ECM. The ECM compares these 2 signals to judge the efficiency of the catalyst and the catalyst's ability to store oxygen. During normal operation, the TWC stores and releases oxygen as needed. The capacity to store oxygen results in a low variation in the post-TWC exhaust stream.

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If the catalyst is functioning normally, the waveform of the heated oxygen sensor slowly switches between RICH and LEAN. If the catalyst is deteriorated, the waveform will alternate frequently between RICH and LEAN. As the catalyst efficiency degrades, its ability to store oxygen is reduced and the catalyst output becomes more variable. When running the monitor, the ECM compares sensor 1 signals (A/F sensor) over a specific amount of time to determine catalyst efficiency. The ECM begins by calculating the signal length for both sensors (for the rear oxygen sensor, the ECM uses the output voltage signal length). If the oxygen sensor output voltage signal length is greater than the threshold (threshold is calculated based on the A/F sensor signal length), the ECM concludes that the catalyst is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0420	Oxygen Storage Capacity (OSC) value is smaller than standard value under active air-fuel ratio control (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (bank 1 sensor 1) • HO2 sensor (bank 1 sensor 2) • Exhaust manifold (TWC)
P0430	OSC value is smaller than standard value under active air-fuel ratio control (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (bank 2 sensor 1) • HO2 sensor (bank 2 sensor 2) • Exhaust manifold (TWC)

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration P0430: Catalyst Deterioration
Required Sensors / Components (Main)	TWC
Required Sensors / Components (Related)	A/F sensor, heated oxygen sensor, intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Approximately 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0011, P0012 (VVT System 1-Advance, Retard), P0021, P0022 (VVT System 2-Adavance, Retard), P0031, P0032, P0051, P0052 (A/F Sensor Heater Sensor 1), P0037, P0038, P0057, P0058 (O2 Sensor heater Sensor 2), P0100, P0101, P0102, P0103 (MAF Sensor), P0115, P0116, P0117, P0118 (ECT Sensor), P0120, P0121, P0122, P0123, P0220, P0222, P0223 , P2135 (TP Sensor), P0125 (Insufficient ECT for Closed Loop), P0136, P0156 (O2 Sensor 2), P0171,P0172 (Fuel System), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP Sensor), P0340 (CMP Sensor), P0351, P0352, P0353, P0354, P0355, P0356 (Ignitor), P0500 (VSS), P2196, P2198 (A/F Sensor (Rationality)), P2A00, P2A03 (A/F Sensor (Slow Response))
Battery voltage	11 V or more
IAT	-10°C (14°F) or more
ECT	75°C (167°F) or more
Atmospheric pressure	0.75 or more
Idle	OFF
Engine RPM	Less than 3200 rpm
A/F sensor	Activated
Fuel system status	Closed loop
Engine load	10 to 70%
All of the following conditions are met	Conditions 1, 2 and 3
1. Mass air flow rate	5 to 60 g/sec.
2. Front catalyst temperature (estimated)	600 to 750°C (1112 to 1382°F)
3. Rear catalyst temperature (estimated)	100 to 900°C (212 to 1652°F)
Rear HO2S monitor	Completed
Shift position	4th or more

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of catalyst	Less than 0.046 g (0.000101 lb)

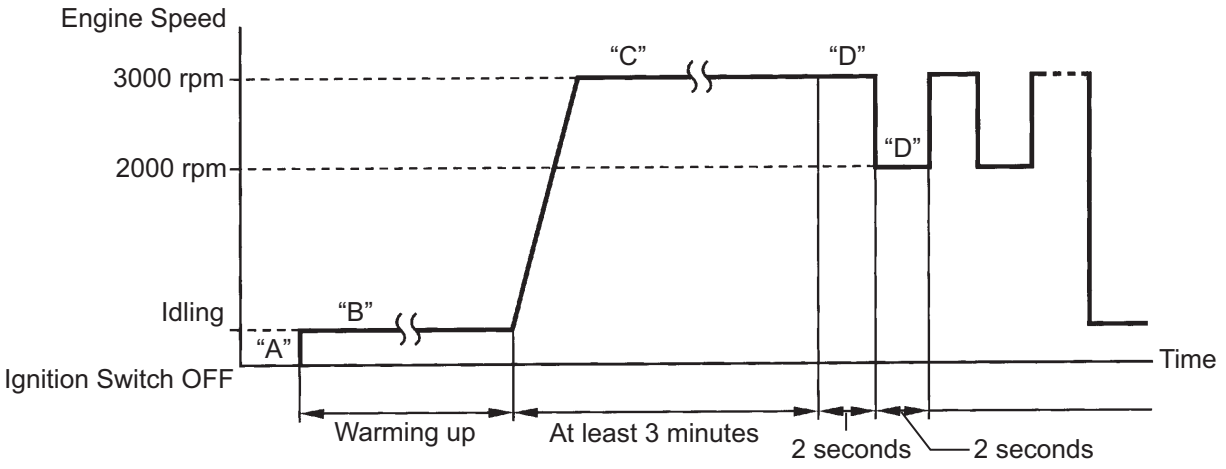
MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-19).

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



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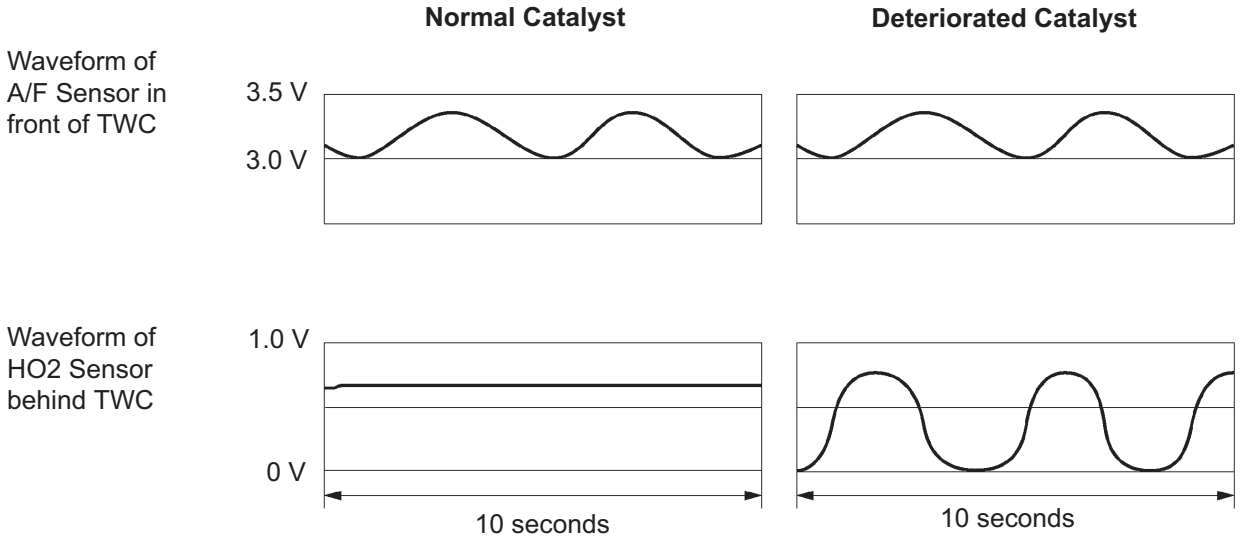
1. Connect the intelligent tester to the DLC3 (Procedure "A").
2. Start the engine and warm it up with all the accessories switched off, until the engine coolant temperature stabilizes (Procedure "B").
3. Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes (Procedure "C").
4. While running the engine at 3000 rpm for 2 seconds and at 2000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester (Procedure "D").
   HINT:
   - If either of the voltage outputs of the Air-Fuel Ratio (A/F) or Heated Oxygen (HO2) sensor does not fluctuate, or either of the sensors makes a noise, the sensor may be malfunctioning.
   - If the voltage outputs of both the sensors remain lean or rich, the air-fuel ratio may be extremely lean or rich. In such cases, perform the following A/F CONTROL using the intelligent tester.
   - If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).

Voltage output when active air-fuel ratio control not performed:



1. A/F CONTROL

HINT:

Intelligent 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 an intelligent tester.

(a) Connect the intelligent tester to the DLC3.

(b) Start the engine and turn the tester on.

(c) Warm up the engine at an engine speed of 2500 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 the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

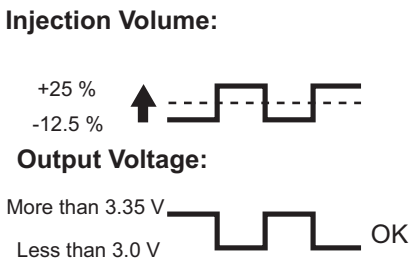
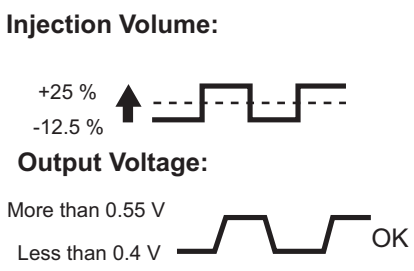
- The A/F CONTROL operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard voltage

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

CAUTION:

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.

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
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 0.4 V  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 3.0 V  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	• Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)

- 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 or AFS B2S1 and O2S B2S2. Press the YES button and then the ENTER button. Then press the F4 button.

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

HINT:
If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART (See page ES-56)**

A

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (A/F CONTROL)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
(d) Select the following menu items on the tester: 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 the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and 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 voltage

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

Result

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensor Conditions	Misfires	Suspected Trouble Areas	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensor Conditions	Misfires	Suspected Trouble Areas	Proceed to
Rich	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B
Lean/Rich	Lean	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A
Rich	Rich	Actual air-fuel ratio rich	-	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A

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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.
Lean/Rich: During A/F CONTROL of the ACTIVE TEST, the output voltage of the HO2 sensor alternates correctly.

B → **REPLACE AIR FUEL RATIO SENSOR**

C → **CHECK AND REPLACE HEATED OXYGEN SENSOR, AND CHECK AND REPAIR EXHAUST GAS LEAKAGE**

A

3 INSPECT FOR EXHAUST GAS LEAK

OK:
No gas leakage.

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

OK

REPLACE THREE-WAY CATALYTIC CONVERTER (EXHAUST MANIFOLD LH OR RH)