DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the Air Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.
In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control, rather than the conventional detecting method, which uses the locus ratio.
The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.
The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and sets a DTC.

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

HINT:
- Bank 1 refers to the bank that includes No. 1 cylinder.
- Bank 2 refers to the bank that does not include No. 1 cylinder.
- 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 (Bank 1) detection P0430: Catalyst (Bank 2) detection
Required Sensors/Components (Main)	Catalyst
Required Sensors/Components (Related)	Heated oxygen sensor, Intake air temperature sensor, Mass air flow meter, Crankshaft position sensor, Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	About 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 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0021 (VVT System 2 - Advance) P0022 (VVT System 2 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (HO2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0351 - P0358 (Igniter) P0500 (VSS) P2196, P2198 (A/F sensor - rationality) P2237, P2240 (A/F sensor - open) P2440 (AIR control valve stuck open) P2441 (AIR control valve stuck close) P2444 (AIP stuck ON) P2445 (AIP stuck OFF) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
Intake air temperature	-10°C (14°F) or more
Engine coolant temperature	75°C (167°F) or more
Atmospheric pressure	76 kPa (570 mmHg) or more
Idle	OFF
Engine RPM	Less than 3,200 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. MAF	6 to 75 g/sec. (Varies with engine RPM)
2. Front catalyst temperature (estimated)	715 to 830°C (1,319 to 1,526°F)
3. Rear catalyst temperature (estimated)	410 to 830°C (770 to 1,526°F)
EVAP system monitor	The monitor has not run yet or the vacuum introduction has been completed
A/F sensor monitor	Completed
Rear HO2S heater monitor	Completed
Shift position	4th or more

TYPICAL MALFUNCTION THRESHOLDS

Oxygen storage capacity (OSC) of catalyst	Less than 0.08 g

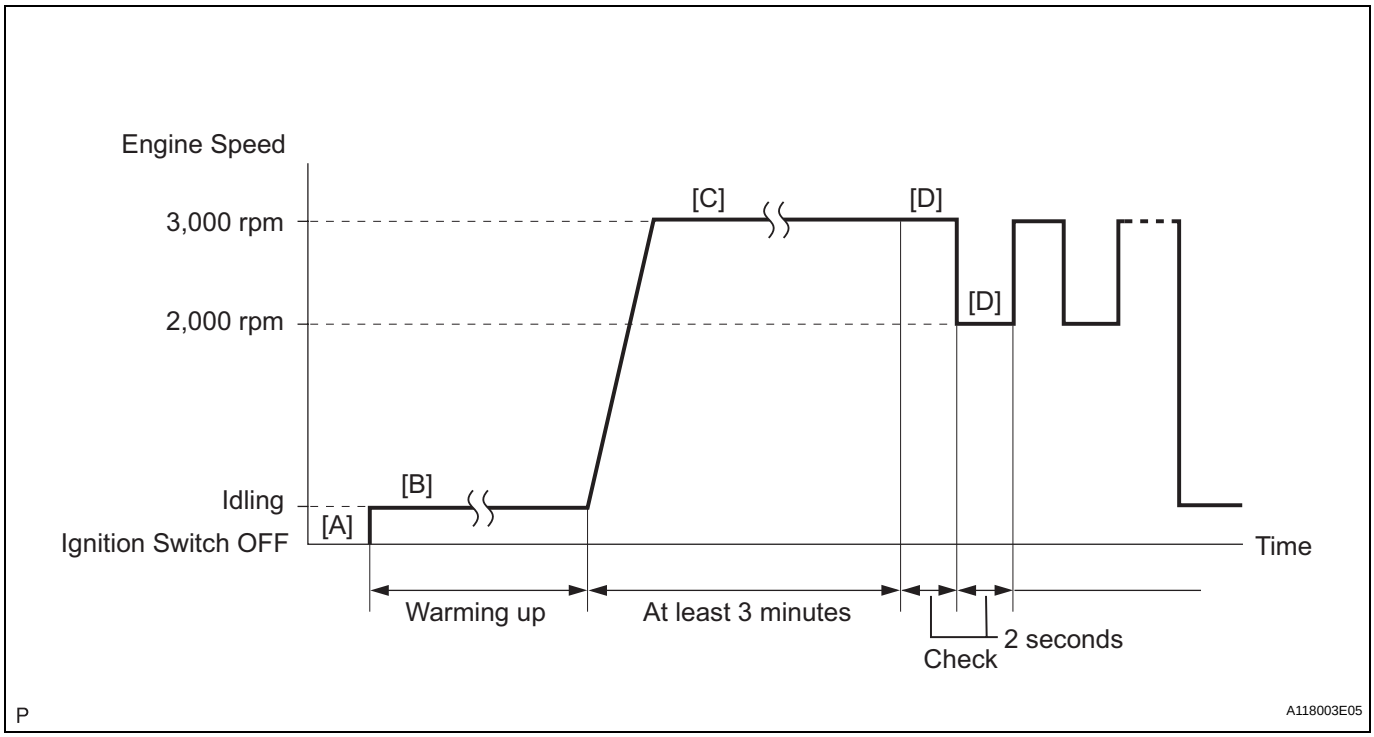
MONITOR RESULT

Detailed information on CHECKING MONITOR STATUS (See page ES-17).

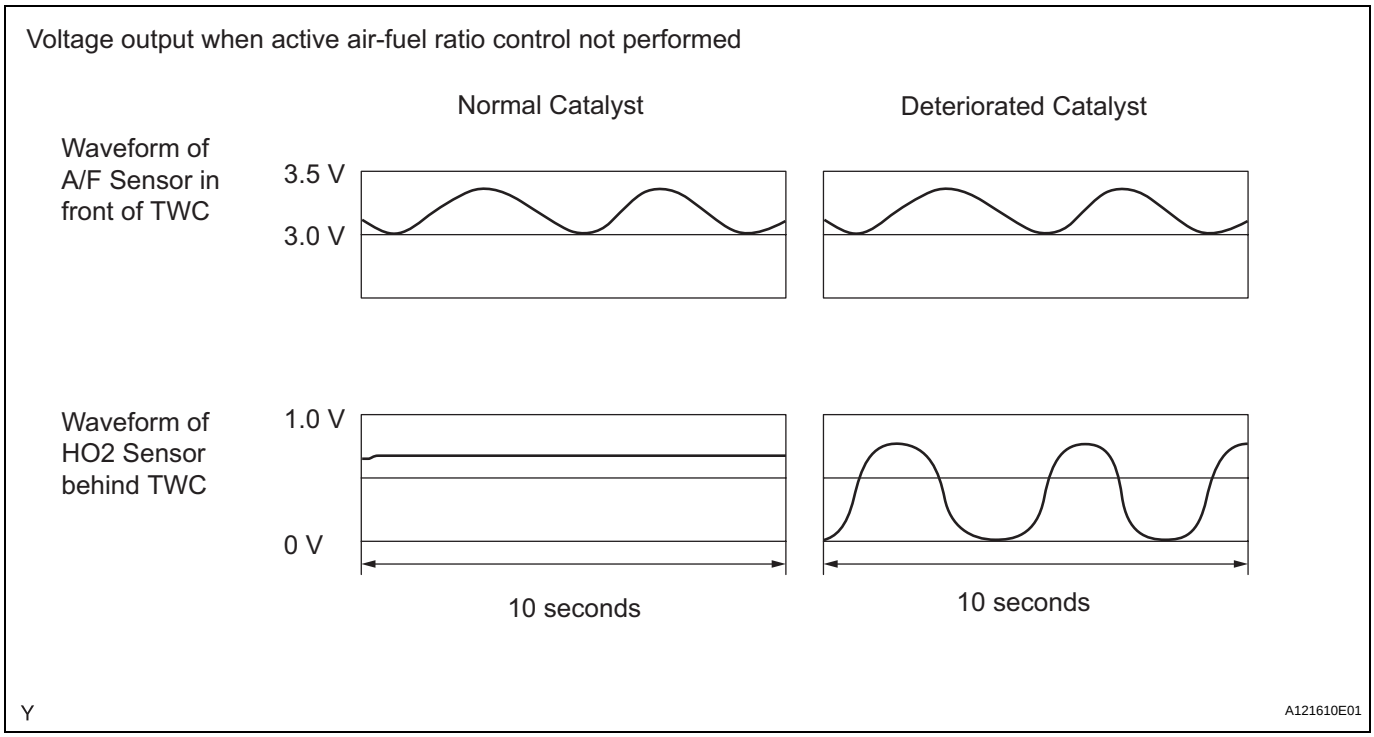
CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and time 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.



1. Connect the intelligent tester to the DLC3 with CAN VIM [A].
2. Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes [B].
3. Run the engine at an engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes [C].
4. While running the engine at 3,000 rpm for 2 seconds and 2,000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester [D].
   HINT:
   - If either of voltage outputs of the Air Fuel Ratio (A/F) or Heated Oxygen (HO2) sensors 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).



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 the intelligent tester.

1. Connect the intelligent tester to the DLC3 with CAN VIM.
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, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
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 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 in the fuel injection volume.

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
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

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.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Fuel injector • Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.
- To display the graph, enter the following menus 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. Then press the YES button and ENTER button, followed by 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 with CAN VIM.
(b) Turn the ignition switch ON and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read 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

A

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

ES

1. Connect the intelligent tester to the DLC3 with CAN VIM.
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, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
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 output voltages 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:

Tester Display (Sensor)	Injection Volume	Status	Voltage
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	Misfire	Main 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	Misfire	Main Suspected Trouble Areas	Proceed to
Rich	Lean/Rich	A/F sensor malfunction	May occur	• 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 lean	-	• Extremely rich or lean actual air fuel ratio • Gas leakage from exhaust system	A

ES

Lean: During A/F CONTROL, the A/F sensor (AFS) output voltage 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, the output voltage of the HO2 sensor alternates correctly.

B → **CHECK AND REPLACE AIR FUEL RATIO SENSOR**

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

A

3 CHECK FOR EXHAUST GAS LEAK

OK:
No gas leakage.

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

OK

REPLACE FRONT AND REAR THREE-WAY CATALYTIC CONVERTER IN BANK A WHERE MALFUNCTION IS DETECTED