DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

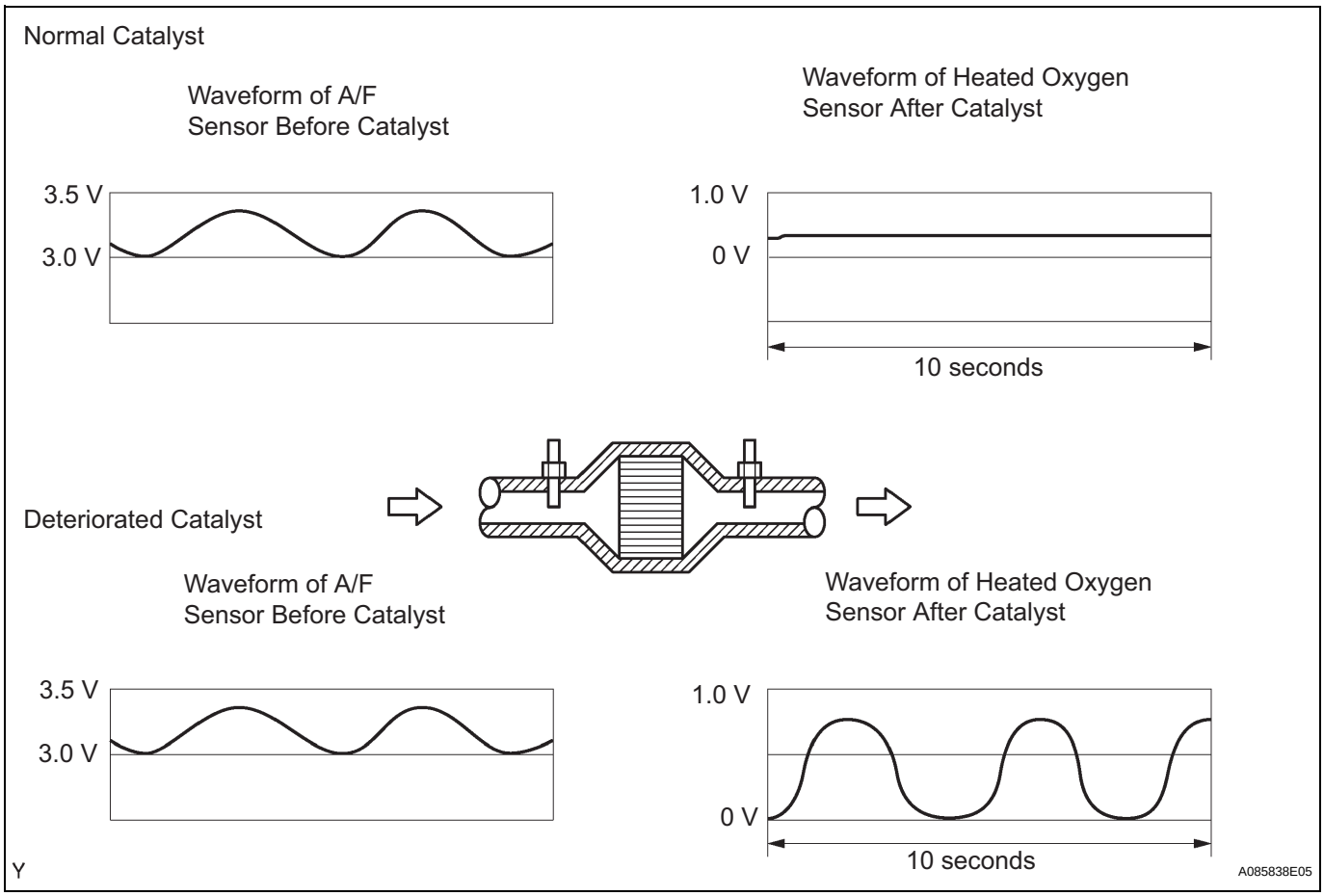
DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

MONITOR DESCRIPTION

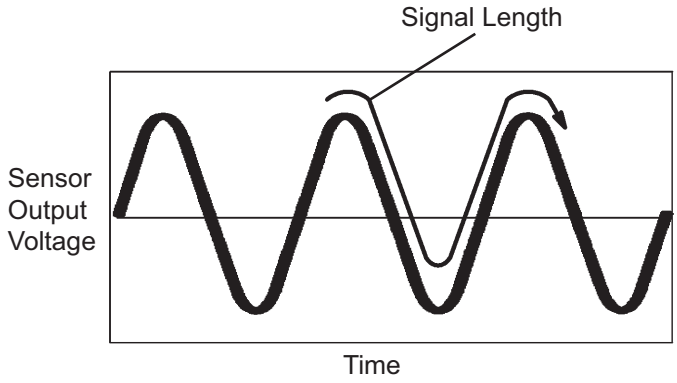
The ECM uses the two sensors, mounted in front of and behind the Three-way Catalytic Converter (TWC), to monitor its efficiency.

The first sensor, the Air-Fuel Ration (A/F) sensor (sensor 1), sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor (sensor 2), sends post-catalyst information to the ECM. The ECM compares the information transmitted by these two sensors to determine the efficiency of the TWC performance and its ability to store oxygen.

When the TWC is functioning properly, the variation in the oxygen concentration in the exhaust gas, after it has passed through the TWC, is small. As a result, the voltage output of sensor 2 slowly alternates between the rich and lean signal voltages (shown in the illustration below). As the TWC performance efficiency deteriorates, its oxygen storage capacity decreases, and the variation in the oxygen concentration in the exhaust gas increases. As a result, the sensor voltage output fluctuates frequently. While the catalyst monitor is running, the ECM measures the signal length of both sensors 1 and 2, and calculate the ratio of the signal lengths to determine the extent of the TWC deterioration. If the deterioration level exceeds the preset threshold, the ECM interprets this as the TWC malfunction. The ECM then illuminates the MIL and sets the DTC.



Heated Oxygen Sensor Signal Length



A082718E03

ES

DTC No.	DTC Detection Condition	Trouble Area
P0420	After engine and TWC warmed up, and while vehicle driven within set vehicle and engine speeds, waveform of Heated Oxygen (HO2) sensor (bank 1 sensor 2) alternates frequently between rich and lean (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (bank 1 sensor 1) • HO2 sensor (bank 1 sensor 2) • Three-Way Catalytic Converter (TWC) (Exhaust manifold)
P0430	After engine and catalyst are warmed up, and while vehicle is driven within set vehicle and engine speed ranges: Waveform of heated oxygen sensor (bank 2 sensor 2) alternates frequently between rich and lean (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 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 (Bank 1) detection P0430: Catalyst (Bank 2) detection
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 par driving cycle
Duration	150 seconds or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0031, P0032, P0051, P0052 (O2 sensor heater sensor 1), 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, P0123, P0220, P0222, P0223, P2135,(TP sensor), P0125 (Insufficient ECT for closed loop), P0136, P0137, P0138, (O2 sensor 1), P0134, P0154 (O2 sensor, A/F sensor (No activity) sensor 1), P0136, P0156 (O2 sensor 2), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0305, P0306, P0308, (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, P0358 (Igniter), P0385 (CKP sensor 2), P0500 (VSS), P2196, P2198 (A/F sensor (Rationality)), P2A00, P2A03 (A/F sensor (Slow response))
Accumulated time that all of the following conditions are met	30 seconds or more
Battery voltage	11 V or more
Intake air temperature	-10°C (14°F) or more
Idle status	OFF
Mass air flow rate	6 to 45 g/sec.
Engine RPM	Less than 3,000 rpm
Engine coolant temperature sensor	75°C (167°F) or more
Fuel system status	Closed loop
Rich experience after fuel cut	Yes
A/F sensor	Activated
Rear HO2S	Activated
Estimated catalyst temperature	Both of following conditions 1 and 2 met
1. Upstream catalyst temperature	500 to 800°C (932 to 1472°F) or more
2. Downstream catalyst temperature	500 to 800°C (932 to 1472°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Rear HO2S locus length	15 V or more (varies with A/F sensor locus length)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-14).

The monitor result (mode 6) allows the OBD scan tool to display the monitor status, test value and test limit. A problem in this component can be found by comparing the test value and test limit. The procedure is described in "CHECKING MONITOR STATUS".

- TID (Test Identification Data) is assigned to each emission-related component.
- TLT (Test Limit Type):
  If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
  If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification) is assigned to each test value.
- Unit Conversation is used to calculate the test value indicated on generic OBD scan tools.

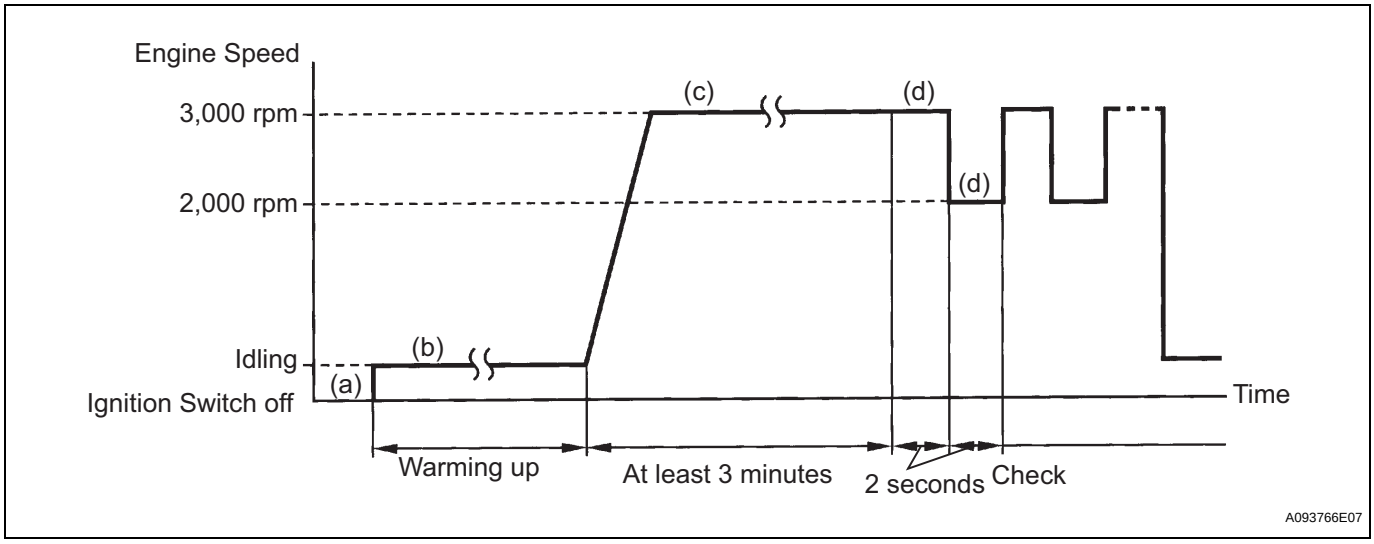
TID $01: Catalyst - Using A/F Sensor and HO2S

TLT	CID	Unit Conversion	Description of Test Value	Description of Test Limit
0	$01	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveform of A/F sensor and HO2S	Malfunction criterion for catalyst deterioration
0	$02	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveform of A/F sensor and HO2S	Malfunction criterion for catalyst deterioration

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 (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 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 or scan tool (d).

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	 OK	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
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	NG	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
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	 OK	Output Voltage Almost no reaction	NG	

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

- 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, and press the YES button and then the ENTER button followed by the F4 button.

ES

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 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 DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)

(a) Connect the intelligent tester to the DLC3.
(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)

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at 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

ES

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
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

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

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

A

ES

3	CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

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

OK

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