Last Modified: 7-13-2007		1.6 C
Service Category: Engine/Hybrid System	**Section:** Engine Control	
Model Year: 2008	**Model:** ES350	**Doc ID:** RM000000WC002MX
Title: 2GR-FE ENGINE CONTROL SYSTEM: SFI SYSTEM: P0420: Catalyst System Efficiency Below Threshold (Bank 1) (2008 ES350)		

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 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 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 P0420: Catalyst Deterioration
Required Sensors/Components (Main)	TWC
Required Sensors/Components (Sub)	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

Monitor runs whenever following DTCs are not present	P0011, 14 (VVT System 1 - Advance) P0012, 15 (VVT System 1 - Retard) P0031, 32, 51, 52 (A/F Sensor heater - Sensor 1) P0037, 38, 58, 59 (O2 Sensor heater - Sensor 2) P0101 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136, P0156(O2 Sensor - Sensor 2) P0171, P0172, P0174, P0175 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0354 (Igniter) 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	70 kPa (525 mmHg) or more
Idle	OFF
Engine RPM	Less than 4000 rpm
A/F sensor	Activated
Fuel system status	Closed loop
Engine load	10 to 70 %
All of the following conditions 1, 2 and 3 are met:	-

1. MAF	6 to 25 g/sec.
2. Front catalyst temperature (estimated)	500 to 800°C (932 to 1472°F)
3. Rear catalyst temperature (estimated)	500 to 800°C (932 to 1472°F)
EVAP system monitor	The monitor has not run yet or the vacuum introduction has been completed.
A/F sensor monitor	Completed
Rear HO2S monitor	Completed
Shift position	3rd or higher

TYPICAL MALFUNCTION THRESHOLDS

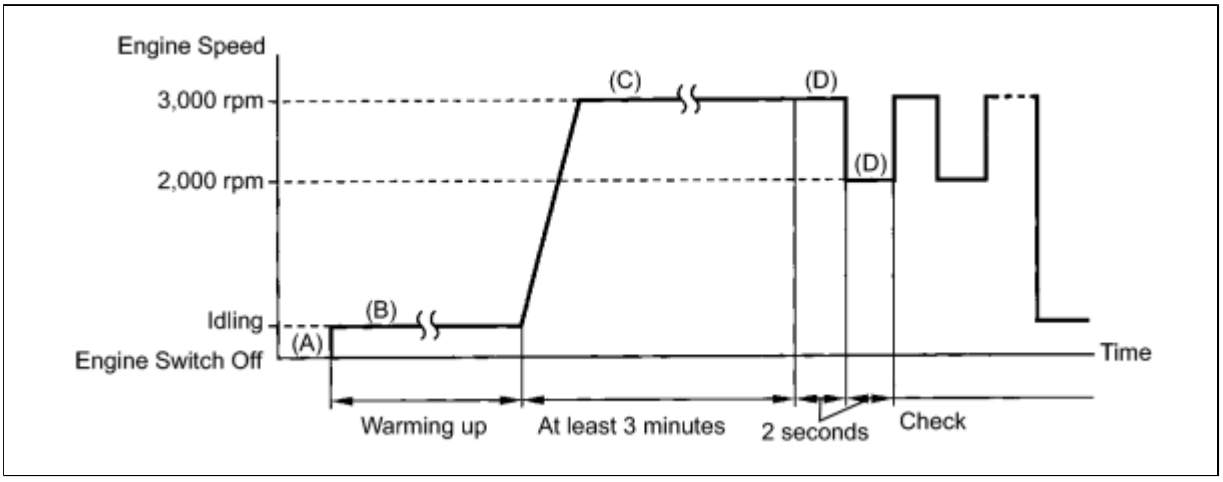
OSC (Oxygen Storage Capacity) of Catalyst	Less than 0.08 g

MONITOR RESULT

Refer to CHECKING MONITOR STATUS INFO .

CONDITIONING FOR SENSOR TESTING

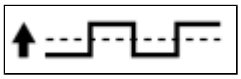
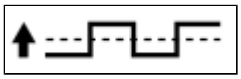
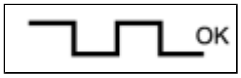
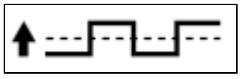
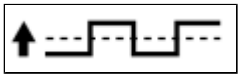
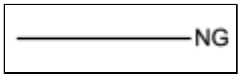
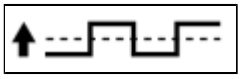
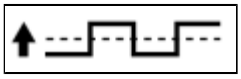
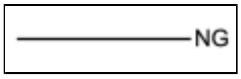
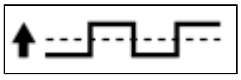
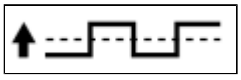
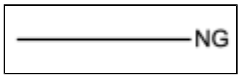
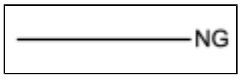
Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is performed in order to heat the sensors sufficiently to obtain the appropriate inspection results.



- Connect Techstream to the DLC3 (Procedure "A").
- Start the engine and warm it up with all the accessories switched off, until the engine coolant temperature stabilizes (Procedure "B").
- Run the engine at an engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes (Procedure "C").
- 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 (Procedure "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		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 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 Control the Injection Volume for A/F Sensor 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: Powertrain / Engine / Active Test / Control the Injection Volume for A/F Sensor / A/F Control System / AFS B1 S1 or AFS B2 S1 and O2S B1 S2 or O2S B2 S2 then press the graph button on the Data List view.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using Techstream. 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 INFO **.**

PROCEDURE

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

(a) Connect Techstream to the DLC3.

(b) Turn the engine switch on (IG) and turn the tester on.

(c) Enter the following menus: Powertrain / Engine / Trouble Code.

(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**

A ▼

2.	**PERFORM ACTIVE TEST BY TECHSTREAM (A/F CONTROL)**

(a) Connect Techstream to the DLC3.

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

(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.

(d) On the tester, enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume for A/F sensor.

(e) Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume.)

(f) Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

- The Control the Injection Volume for A/F sensor 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.

TESTER DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	VOLTAGE
AFS B1 S1 or AFS B2 S1 (A/F)	+25 %	Rich	Less than 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5 %	Lean	More than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25 %	Rich	More than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5 %	Lean	Less than 0.4 V

Result:

STATUS AFS B1 S1 OR AFS B2 S1	STATUS O2S B1 S2 OR O2S B2 S2	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:

Rich:

Lean/Rich:

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

4.	CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)

(a) Connect Techstream to the DLC3.

(b) Turn the engine switch on (IG) and turn the tester on.

(c) Enter the following menus: Powertrain / Engine / Trouble Code.

(d) Read the DTCs

Result:

DISPLAY (DTC OUTPUT)	PROCEED TO
P0420	A
P0430	B
P0420 and P0430	A and B

B ▶ REPLACE EXHAUST MANIFOLD SUB-ASSEMBLY LH

A

5.	REPLACE EXHAUST MANIFOLD SUB-ASSEMBLY RH

(a) Replace the exhaust manifold sub-assembly RH INFO .

NEXT ▶ REPLACE FRONT EXHAUST PIPE ASSEMBLY

6.	REPLACE EXHAUST MANIFOLD SUB-ASSEMBLY LH

(a) Replace the exhaust manifold sub-assembly LH INFO .

NEXT ▶ REPLACE FRONT EXHAUST PIPE ASSEMBLY