## DTC P0420 Catalyst System Efficiency Below Threshold (Bank 1)

## DTC P0430 Catalyst System Efficiency Below Threshold (Bank 2)

**for Preparation** Click here

## MONITOR DESCRIPTION

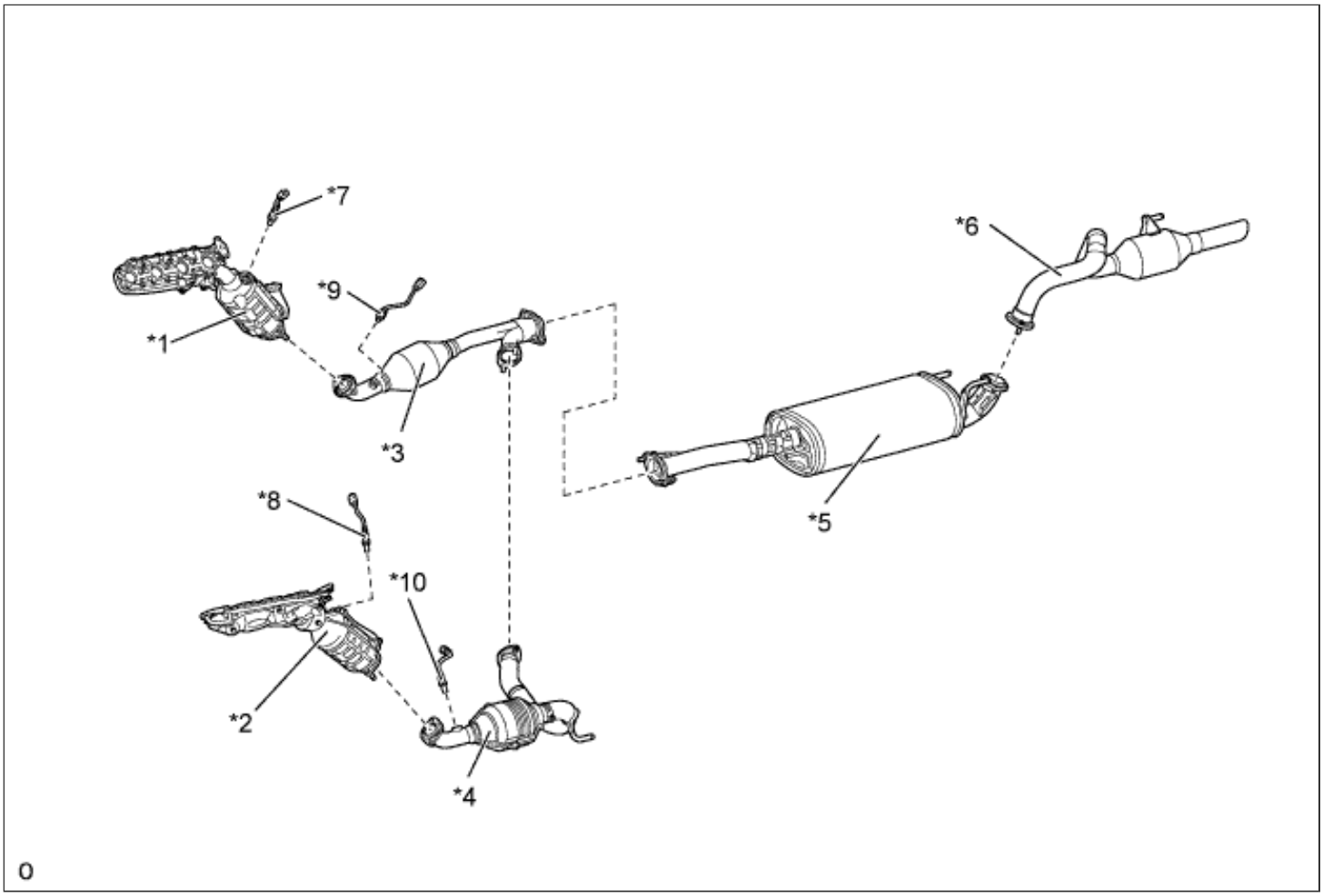
The ECM uses sensors mounted in front of and behind the Three-way Catalytic Converter (TWC) to monitor its efficiency.
The first sensor, the air fuel ratio sensor, sends pre-catalyst information to the ECM. The second sensor, the heated oxygen sensor, sends post-catalyst information to the ECM.
In order to detect any deterioration in the Three-way Catalytic Converter (TWC), the ECM calculates the Oxygen Storage Capacity (OSC) of the Three-way Catalytic Converter (TWC). This calculation is based on the voltage output of the heated oxygen sensor while performing active air-fuel ratio control.
The OSC value is an indication of the oxygen storage capacity of the Three-way Catalytic Converter (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 the rich-lean cycle of the heated oxygen sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the heated oxygen sensor and Three-way Catalytic Converter (TWC).
The ECM uses the OSC value to determine the state of the Three-way Catalytic Converter (TWC). If any deterioration has occurred, it illuminates the MIL and stores the DTC.

| DTC No. | DTC Detection Condition | Trouble Area |
|---|---|---|
| P0420 | OSC value is less than the standard value under active air-fuel ratio control (2 trip detection logic). | • Gas leak from exhaust system<br>• Air fuel ratio sensor (for Bank 1 Sensor 1)<br>• Heated oxygen sensor (for Bank 1 Sensor 2)<br>• Exhaust manifold assembly LH (TWC: Front catalyst)<br>• Front No. 2 exhaust pipe assembly (TWC: Rear catalyst)<br>• EGR valve assembly |
| P0430 | OSC value is less than the standard value under active air-fuel ratio control (2 trip detection logic). | • Gas leak from exhaust system<br>• Air fuel ratio sensor (for Bank 2 Sensor 1)<br>• Heated oxygen sensor (for Bank 2 Sensor 2)<br>• Exhaust manifold assembly RH (TWC: Front catalyst)<br>• Front exhaust pipe assembly (TWC: Rear catalyst)<br>• EGR valve assembly |

**HINT:**

- **DTC P0420 and P0430 are for Euro-OBD only.**
- **Bank 1 refers to the bank that includes the No. 1 cylinder.**
- **Bank 2 refers to the bank that does not include the 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.**

## CATALYST LOCATION




**Text in Illustration**

| | | | |
|---|---|---|---|
| *1 | Exhaust Manifold Assembly RH (TWC: Front catalyst) | *2 | Exhaust Manifold Assembly LH (TWC: Front catalyst) |
| *3 | Front Exhaust Pipe Assembly (TWC: Rear catalyst) | *4 | Front No. 2 Exhaust Pipe Assembly (TWC: Rear catalyst) |
| *5 | Center Exhaust Pipe Assembly | *6 | Tailpipe Assembly |
| *7 | Air Fuel Ratio Sensor (for Bank 2 Sensor 1) | *8 | Air Fuel Ratio Sensor (for Bank 1 Sensor 1) |
| *9 | Heated Oxygen Sensor (for Bank 2 Sensor 2) | *10 | Heated Oxygen Sensor (for Bank 1 Sensor 2) |

## MONITOR STRATEGY

| | |
|---|---|
| Required Sensors/Components (Main) | Air fuel ratio sensor and heated oxygen sensor heater |
| Required Sensors/Components (Related) | Intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor |
| Frequency of Operation | Once per driving cycle |

## TYPICAL ENABLING CONDITIONS

| | |
|---|---|
| Battery voltage | 11 V or higher |
| Intake air temperature | -10°C (14°F) or higher |
| Engine coolant temperature | 75°C (167°F) or higher |
| Atmospheric pressure | 76 kPa (570 mmHg) or higher |
| Idling | OFF |
| Engine speed | Less than 3200 rpm |
| Air fuel ratio sensor status | Activated |
| Fuel system status | Closed loop |
| Engine load | 10 to 75% |
| All of following conditions (a), (b) and (c) met | - |
| (a) Mass air flow | 7.5 to 75 g/sec. |
| (b) Estimated front catalyst temperature | 650 to 820°C (1202 to 1508°F) |
| (c) Estimated rear catalyst temperature | 400 to 700°C (752 to 1292°F) |
| Transmission gear | 4th or higher |

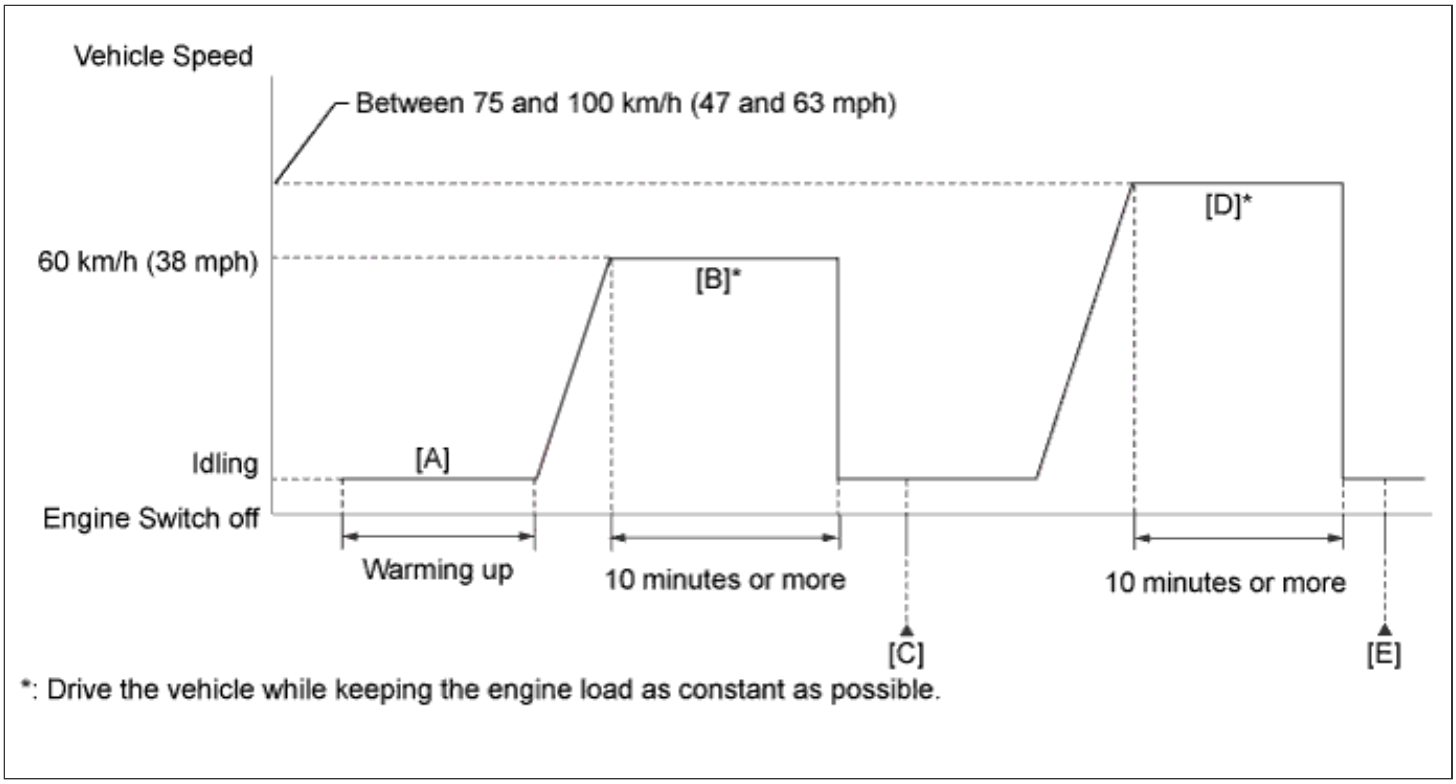
**HINT:**

The estimated catalyst temperature can be read in the Data List using the intelligent tester.

## CONFIRMATION DRIVING PATTERN

**HINT:**

Performing this confirmation driving pattern will activate the catalyst monitor. This is very useful for verifying the completion of a repair.



1. Connect the intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Clear DTCs (even if no DTCs are stored, perform the clear DTC operation).
5. Turn the engine switch off and wait for at least 30 seconds.
6. Turn the engine switch on (IG) and turn the tester on.
7. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher [A].
8. Drive the vehicle at approximately 60 km/h (38 mph) for 10 minutes or more [B].

**HINT:**

Drive the vehicle while keeping the engine load as constant as possible.

**CAUTION:**

When performing the confirmation driving pattern, obey all speed limits and traffic laws.

9. Enter the following menus: Powertrain / Engine and ECT / DTC [C].
10. Read the pending DTCs.

**HINT:**

- **If a pending DTC is output, the system is malfunctioning.**
- **If a pending DTC is not output, perform the following procedure.**

11. Enter the following menus: Powertrain / Engine and ECT / Utility / All Readiness.
12. Input the DTC: P0420 or P0430.
13. Check the DTC judgment result.

| Tester Display | Description |
|---|---|
| NORMAL | • DTC judgment completed<br>• System normal |
| ABNORMAL | • DTC judgment completed<br>• System abnormal |
| INCOMPLETE | • DTC judgment not completed<br>• Perform driving pattern after confirming DTC enabling conditions |
| UNKNOWN | • Unable to perform DTC judgment<br>• Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit |

**HINT:**

- **If the judgment result shows NORMAL, the system is normal.**
- **If the judgment result shows ABNORMAL, the system has a malfunction.**
- **If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] through [E].**

14. Drive the vehicle at a speed between 75 and 100 km/h (47 and 63 mph) for 10 minutes or more [D].

**HINT:**

Drive the vehicle while keeping the engine load as constant as possible.

**CAUTION:**

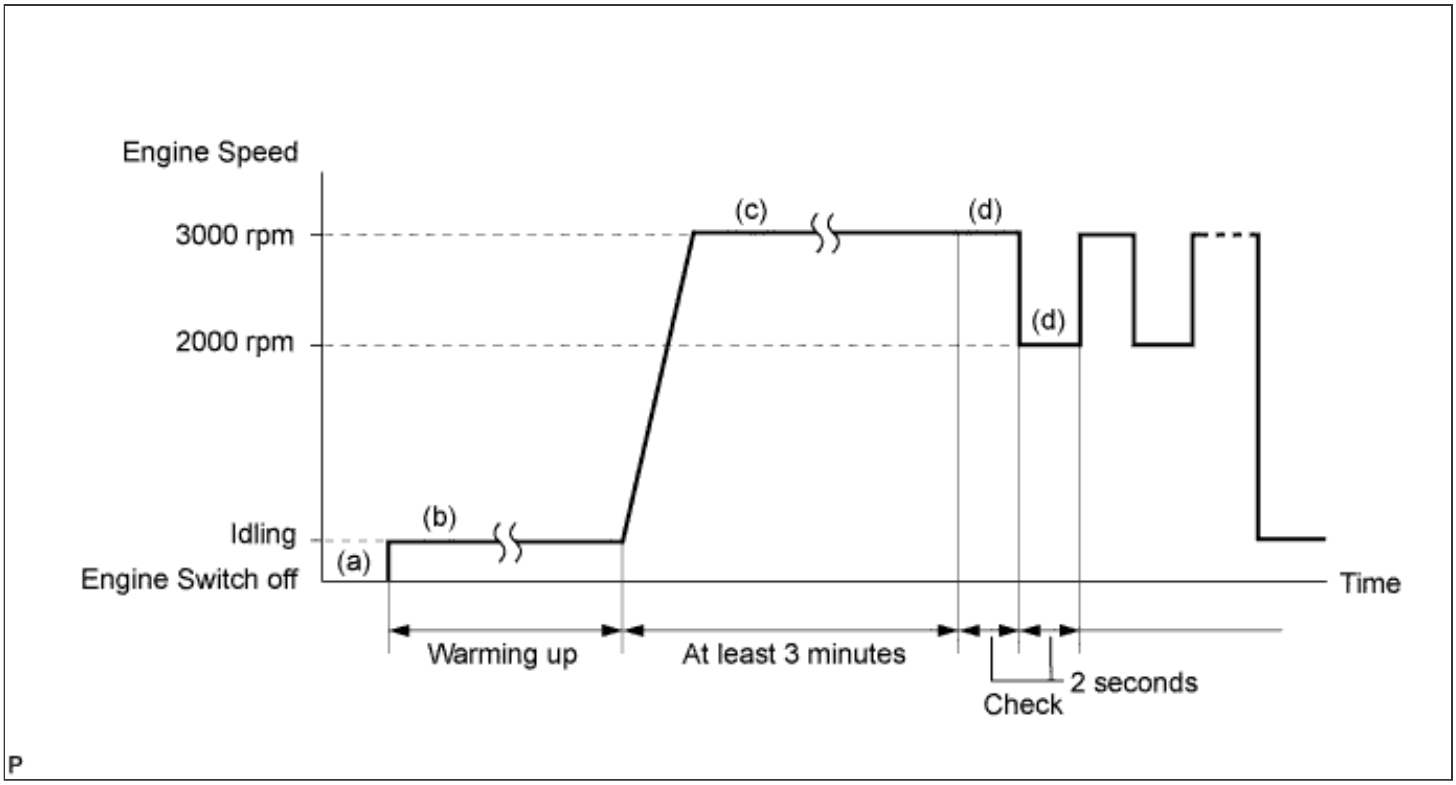
When performing the confirmation driving pattern, obey all speed limits and traffic laws.

15. Check the DTC judgment result again [E].

## CONDITIONING FOR SENSOR TESTING

**HINT:**

Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the air fuel ratio and heated oxygen sensors. This is to activate the sensors sufficiently to obtain appropriate inspection results.



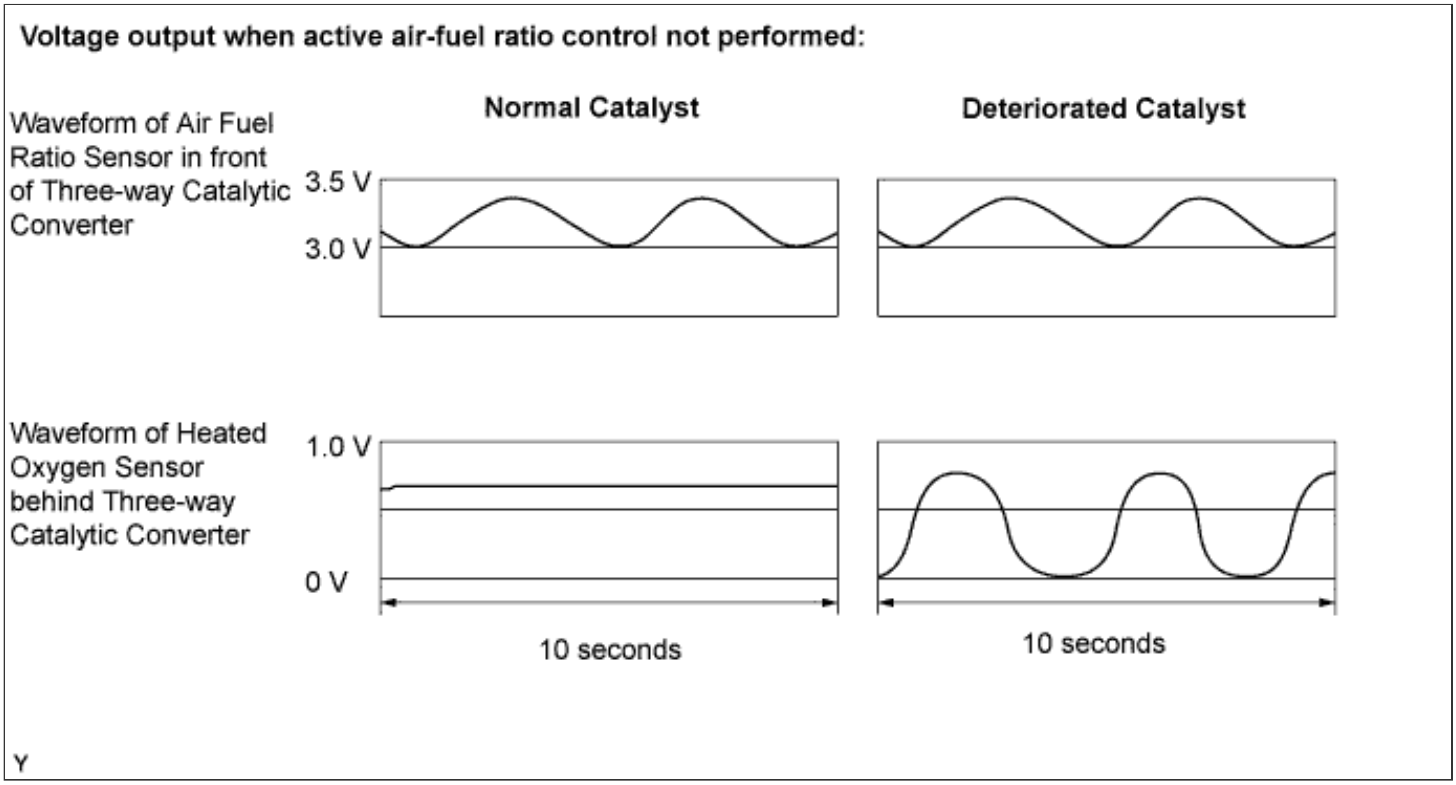

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and warm it up with all the accessories switched off until the engine coolant temperature stabilizes.
(c) Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
(d) While running the engine at 3000 rpm for 2 seconds, and then 2000 rpm for 2 seconds, check the waveforms of the air fuel ratio and heated oxygen sensors using the intelligent tester.

**HINT:**

- **If the voltage output of either the air fuel ratio or heated oxygen sensor does not fluctuate, or there is a noise in the waveform of either sensor, 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 Control the Injection Volume for A/F Sensor Active Test using the intelligent tester.**
- **If the Three-way Catalytic Converter (TWC) has deteriorated, the heated oxygen sensor (located behind the Three-way Catalytic Converter (TWC)) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).**

**Result of real-vehicle check**

| | | | |
|---|---|---|---|
| Engine Speed | 3000 rpm (without load) | 2000 rpm (during fuel-cut) | 2000 rpm (revving up the engine) |
| AFS Voltage B1S1 | 3.263 to 3.302 V | 4.996 V | 3.195 V |
| O2S B1S2 | 0.820 to 0.835 V | 0.015 V | 0.820 V |




## INSPECTION PROCEDURE

**HINT:**

- **After performing repairs, drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern and check if DTC P0420 or P0430 is output again. If a DTC is output again, replace the catalyst if it has not been replaced already.**
- **Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, 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 FOR ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 OR P0430)**

**a.** Connect the intelligent tester to the DLC3.

**b.** Turn the engine switch on (IG).

**c.** Turn the tester on.

**d.** Enter the following menus: Powertrain / Engine and ECT / DTC.

**e.** Read DTCs.

**Result**

| Result | Proceed to |
|---|---|
| P0420 or P0430 is output | A |
| P0420 or P0430 and other DTCs are output | B |

**HINT:**

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

**B** → **GO TO DTC CHART (Click here)**

**A**

**2.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE INJECTION VOLUME)**

**a.** Connect the intelligent tester to the DLC3.

**b.** Start the engine.

**c.** Turn the tester on.

**d.** Warm up the engine and run the engine at an engine speed of 2500 rpm for approximately 90 seconds.

**e.** Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume.

**f.** Perform the Control the Injection Volume operation with the engine idling.

**g.** Monitor the voltage outputs of the air fuel ratio and heated oxygen sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

**HINT:**

- **Change the fuel injection volume within the range of - 12.0% to +12.0%. The injection volume can be changed in fine gradations.**
- **The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.**

| Tester Display (Sensor) | Injection Volume | Status | Voltage |
|---|---|---|---|
| AFS Voltage B1S1 or AFS Voltage B2S1 (Air fuel ratio) | +12% | Rich | Below 3.1 V |
| AFS Voltage B1S1 or AFS Voltage B2S1 (Air fuel ratio) | -12% | Lean | Higher than 3.4 V |
| O2S B1S2 or O2S B2S2 (Heated oxygen) | +12% | Rich | Higher than 0.55 V |
| O2S B1S2 or O2S B2S2 (Heated oxygen) | -12% | Lean | Below 0.4 V |

**Result:**

| Status of AFS Voltage B1S1 or AFS Voltage B2S1 | Status of O2S B1S2 or O2S B2S2 | Air Fuel Ratio Condition and Air Fuel Ratio and Heated Oxygen Sensor Condition | Misfire | Suspected Trouble Area | Proceed to |
|---|---|---|---|---|---|
| Lean/Rich | Lean/Rich | Normal | - | • Three-way catalytic converter<br>• Gas leaks from exhaust system<br>• EGR valve assembly | A |
| Lean | Lean/Rich | Air fuel ratio sensor malfunction | - | Air fuel ratio sensor | B |
| Rich | Lean/Rich | Air fuel ratio sensor malfunction | - | Air fuel ratio sensor | B |
| Lean/Rich | Lean | Heated oxygen sensor malfunction | - | • Heated oxygen sensor<br>• Gas leaks from exhaust system | C |
| Lean/Rich | Rich | Heated oxygen sensor malfunction | - | • Heated oxygen sensor<br>• Gas leaks from exhaust system | C |
| Lean | Lean | Actual air fuel ratio lean | May occur | • Extremely rich or lean actual air fuel ratio<br>• Gas leaks from exhaust system<br>• EGR valve assembly | D |
| Rich | Rich | Actual air fuel ratio rich | - | • Extremely rich or lean actual air fuel ratio | D |

| | | | | | |
|---|---|---|---|---|---|
| | | | | • Gas leaks from exhaust system<br>• EGR valve assembly | |

Lean: During the Control the Injection Volume Active Test, the air fuel ratio sensor output voltage (AFS Voltage) is consistently higher than 3.4 V, and the heated oxygen sensor output voltage (O2S) is consistently below 0.4 V.
Rich: During the Control the Injection Volume Active Test, the AFS Voltage is consistently below 3.1 V, and the O2S is consistently higher than 0.55 V.
Lean/Rich: During the Control the Injection Volume Active Test, the output voltage of the air fuel ratio sensor and heated oxygen sensor alternate correctly.

**h.** Refer to "Data List / Active Test" [AFS Voltage B1S1, AFS Voltage B2S1, O2S B1S2 and O2S B2S2] (Click here).

| | |
|---|---|
| **B** | **REPLACE AIR FUEL RATIO SENSOR (Click here)** |
| **C** | **Go to step 7** |
| **D** | **Go to step 8** |

**A**

**3.CHECK FOR EXHAUST GAS LEAK**

**a.** Inspect for exhaust gas leaks from the exhaust manifold sub-assembly and exhaust pipes.

**OK:**
**No gas leaks.**

| | |
|---|---|
| **NG** | **REPAIR OR REPLACE EXHAUST GAS LEAK POINT** |

**OK**

**4.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE EGR STEP POSITION)**

**a.** Connect the intelligent tester to the DLC3.

**b.** Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher.

**HINT:**

- **When performing the Active Test, make sure the shift lever is in P or N.**
- **The A/C switch and all accessory switches should be off.**

**c.** Turn the tester on.

**d.** Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the EGR Step Position.

**e.** Confirm that Throttle Idle Position is ON and check the engine idling condition and the value of MAP in the Data List while performing the Active Test.

**HINT:**

- **Do not leave the EGR valve open for 10 seconds or more during the Active Test.**
- **Be sure to return the EGR valve to step 0 when the Active Test is completed.**

**OK:**
**MAP and idling condition change in response to EGR step position as follows.**

**Standard:**

| - | EGR Step Position (Active Test) | |
|---|---|---|
| | Step 0 | Step 0 to 30 |
| Idling condition | Steady idling | Idling changes from steady to rough idling or engine stalls |
| MAP (Data List) | 20 to 40 kPa (150 to 300 mmHg) | MAP value is at least 10 kPa (75 mmHg) higher than when EGR valve is fully closed |

| | |
|---|---|
| **OK** | **Go to step 6** |
| **NG** | **Go to step 5** |

## 5.INSPECT EGR VALVE ASSEMBLY

**a.** Remove the EGR valve assembly (Click here).

**b.** Check if the EGR valve is stuck open.

**OK:**
**EGR valve is tightly closed.**

| | |
|---|---|
| **NG** | **REPLACE EGR VALVE ASSEMBLY (Click here)** |

**OK**

## 6.CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)

**a.** According to the DTCs output above (Check for Any Other DTCs Output), proceed to the next step referring to the table below.

**Result**

| Result | Proceed to |
|---|---|

| | |
|---|---|
| P0420 is output | A |
| P0430 is output | B |
| P0420 and P0430 are output | A and B |

B → REPLACE EXHAUST MANIFOLD ASSEMBLY RH AND FRONT EXHAUST PIPE ASSEMBLY (TWC: FRONT CATALYST AND REAR CATALYST) (Click here)

A

REPLACE EXHAUST MANIFOLD ASSEMBLY LH AND FRONT NO. 2 EXHAUST PIPE ASSEMBLY (TWC: FRONT CATALYST AND REAR CATALYST) (Click here)

**7.CHECK FOR EXHAUST GAS LEAK**

**a.** Inspect for exhaust gas leaks from the exhaust manifold assembly and exhaust pipes.

**OK:**
**No gas leaks.**

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

REPLACE HEATED OXYGEN SENSOR (Click here)

**8.CHECK FOR EXHAUST GAS LEAK**

**a.** Inspect for exhaust gas leaks from the exhaust manifold assembly and exhaust pipes.

**OK:**
**No gas leaks.**

NG → REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK

**9.PERFORM ACTIVE TEST USING INTELLIGENT TESTER (CONTROL THE EGR STEP POSITION)**

**a.** Connect the intelligent tester to the DLC3.

**b.** Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher.

**HINT:**

- **When performing the Active Test, make sure the shift lever is in P or N.**
- **The A/C switch and all accessory switches should be off.**

c. Turn the tester on.

d. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the EGR Step Position.

e. Confirm that Throttle Idle Position is ON and check the engine idling condition and the value of MAP in the Data List while performing the Active Test.

**HINT:**

- **Do not leave the EGR valve open for 10 seconds or more during the Active Test.**
- **Be sure to return the EGR valve to step 0 when the Active Test is completed.**

**OK:**
**MAP and idling condition change in response to EGR step position as follows.**

**Standard:**

| - | EGR Step Position (Active Test) | |
|---|---|---|
| | Step 0 | Step 0 to 30 |
| Idling condition | Steady idling | Idling changes from steady to rough idling or engine stalls |
| MAP (Data List) | 20 to 40 kPa (150 to 300 mmHg) | MAP value is at least 10 kPa (75 mmHg) higher than when EGR valve is fully closed |

| | |
|---|---|
| OK | CHECK CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO |
| NG | Go to step 10 |

**10.INSPECT EGR VALVE ASSEMBLY**

a. Remove the EGR valve assembly (Click here).

b. Check if the EGR valve is stuck open.

**OK:**
**EGR valve is tightly closed.**

| | |
|---|---|
| NG | REPLACE EGR VALVE ASSEMBLY (Click here) |

OK

**CHECK CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO**